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Comparison between Segmental Thoracic Spinal Anesthesia and General Anesthesia in Breast Cancer Surgery

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Abstract
Background: *Segmental thoracic spinal anesthesia (STSA) selectively administers local anesthetic agents to specific thoracic spinal segments, providing regional anesthesia below the targeted area. Conversely, general anesthesia (GA) induces unconsciousness and immobility by administering anesthetic drugs systemically. This study aimed to compare the efficacy ofsegmental thoracic spinal anesthesia and general anesthesiain breast cancer surgery.*
Methods: *This multicenter comparative observational study was conducted at the Department of Anesthesiology, in multiple hospitals in Dhaka from September 2023 to November 2023. As the study subjects, a total of 60 scheduled female patients for breast cancer surgery were enrolled and divided into two equal groups randomly. In the STSA group, segmental thoracic spinal anesthesia and in the GA group, general anesthesia was used. Data was analyzed by using the SPSS version 23.0 program.*
Results: *STSA group patients took 119.8±41.2 minutes while GA group patients took 218.3±50.4 minutes in the recovery room (p<0.001). In comparing the patient as well as surgeon satisfaction scores between STSA and GA groups, we found significant differences where the p-values were <0.001 and 0.002 respectively. Total opioid consumption (µg) was found significantly lower in the STSA group (p<0.001). Moreover, urine retention was less frequent in the STSA group (p=0.012).**Conclusion:*** *In breast cancer surgery, segmental thoracic spinal anesthesia demonstrates superiority over general anesthesia, with advantages such as shorter recovery times, higher patient and surgeon satisfaction scores, and fewer postoperative complications.*
Keywords: *Comparison, Segmental thoracic spinal anesthesia, General Anesthesia, Breast cancer, Surgery*

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I. Introduction

Breast cancer stands as the most commonly diagnosed and deadliest cancer among women worldwide, with its incidence and the necessity for surgical intervention seemingly on the rise [1]. Utilizing segmental thoracic spinal anesthesia (STSA) offers effective pain management while preserving respiratory function. However, its application demands expertise to mitigate potential complications, including inadvertent dural puncture and spinal cord trauma [2]. Despite its widespread use, general anesthesia (GA) for breast cancer surgeries brings about a surgical stress response and often requires additional medications for postoperative pain relief, leading to adverse effects like nausea, vomiting, and respiratory depression [3]. Thoracic spinal anesthesia selectively blocks cardiac sympathetic fibers, providing advantages such as stress response attenuation during surgery, enhanced myocardial oxygen balance, and stabilized hemodynamic parameters [4]. Additionally, alternative regional anesthesia techniques like thoracic paravertebral blocks, intercostal nerve blocks, and pectoral nerve block types 1 and 2 [1] offer viable options for mastectomy procedures. Note that STSA's specific blockade of cardiac sympathetic fibers offers potential patient benefits including inhibition of the surgical stress response, increased myocardial oxygen balance, and stabilization of intraoperative hemodynamics [5,6]. This is particularly crucial for patients with cardiac morbidity [7]. Although the preemptive analgesic effect of spinal anesthesia is widely accepted in clinical research, it lacks definitive scientific evidence [8]. Studies have shown that STSA combined with local anesthetics and opioids yields better outcomes post-breast surgery compared to GA [9,10]. Female breast cancer, the fifth leading cause of cancer-related death, is more frequently detected than lung cancer [11]. It's long been recognized that surgery compromises immune system function [12]. The main contributing variables to surgery-related stress responses include the surgical procedure itself, neuroendocrine stress responses, anesthetic medications like opioid analgesics, and postoperative pain [13,14].

II. Methodology

This was a multi-center comparative observational study that was conducted at theDepartment of Anesthesiology in multiple hospitals from September 2023 to November 2023. A total of 60 scheduled female patients for breast cancer surgery were enrolled in the study and randomly divided into two equal groups. In the STSA group, segmental thoracic spinal anesthesia was administered, while in the GA group, general anesthesia was used. According to the inclusion criteria of this study, patients classified as American Society of Anesthesiologists (ASA) physical status I-III, diagnosed with primary breast cancer without known extension beyond the breast and axillary nodes, were included. Conversely, the exclusion criteria encompassed patients diagnosed with inflammatory breast cancer, individuals who had undergone prior surgery for breast cancer, and any condition contraindicating spinal anesthesia. Upon OR arrival, standard ASA monitoring began. IV access was established, and Ringer's acetate solution was administered. Patients were assigned to receive segmental thoracic spinal anesthesia (STSA) or general anesthesia (GA). STSA group patients received IV fentanyl and IV Midazolam before thoracic spinal block placement. Patients were positioned laterally, and the T5–T6 puncture site was infiltrated with 3ml of 1% lignocaine. Puncture used a 27‑G Quincke spinal needle. Once the ligamentumflavum was pierced, the needle's stylet was withdrawn, and CSF flow was confirmed in the hub. A mixture of 1mL 0.5% isobaric bupivacaine and 20 µg fentanyl (total volume 1.4mL) was then injected upon confirming the clear CSF flow. Patients were positioned supine, and sensory block onset (from T2 to T8) was assessed every 2 min. If the sensory block was not achieved in the required dermatome after 10 min, the block was considered failed, and patients were given standard GA and excluded. In the GA group, patients received premedication with IV fentanyl (1-2 mg/kg) and IV midazolam (0.02 mg/kg). Pre-oxygenation was performed with 6–8 L/min flow and 1.0 FiO2 of oxygen for 3 minutes. Anesthesia induction utilized IV propofol (2.0–2.5 mg/kg), and intubation was facilitated with IV atracuriumbesylate (0.5 mg/kg). Maintenance of anesthesia consisted of 1.0–1.2% isoflurane with 40% oxygen in the air. Neuromuscular blockade reversal occurred with 50 µg/kg of neostigmine and 10 µg/kg of glycopyrrolate at the end of surgery. Vital signs, including mean arterial pressure (MAP), heart rate (HR), oxygen saturation (SpO2), and respiratory rate (RR), were monitored at 5-minute intervals from induction until the end of surgery. Episodes of hypotension (defined as a decrease in MAP by 30% from baseline) and bradycardia (HR < 60 beats/min) were managed with IV crystalloid boluses, IV atropine (0.01 mg/kg) for significant bradycardia (HR < 40 beats/min). Any occurrence of paresthesia, nausea, vomiting, pruritus, or urinary retention was noted. Anesthesia quality was assessed using numeric parameters such as patient satisfaction (scored 0–10), surgeon satisfaction (scored 0–10), and periodic visual analog scale (VAS) scores. The data were analyzed using SPSS version 23.0, and a significance level of $p < 0.05$ was used for statistical analysis.

III. Result

In this study, upon analyzing the demographic data, it was noted that the mean ±SD ages in the STSA and GA groups were 50.8 ± 9.1 and 51.2 ± 8.7 years, respectively, while the mean ±SD BMIs were 25.3 ± 1.4 and 24.9 ± 1.6 Kg/m², respectively. No significant differences were found between the groups in terms of age or BMI, with p-values exceeding 0.05. Additionally, when comparing the ASA scores between the STSA and GA groups, it was observed that the majority of participants in both groups had ASA score II, followed by ASA score I and ASA score III. There were no significant differences between the groups regarding the ASA scores ($p > 0.05$). In the recovery room, patients in the STSA group spent 119.8 ± 41.2 minutes, whereas those in the GA group spent 218.3 ± 50.4 minutes, with a significant difference noted ($p < 0.001$). Furthermore, significant differences were observed in both patient and surgeon satisfaction scores between the STSA and GA groups, with p-values < 0.001 and 0.002, respectively. Additionally, total opioid consumption (µg) was significantly lower in the STSA group compared to the GA group, with a p-value also less than 0.001. In contrast, regarding postoperative complications, a significant difference was observed only in urine retention, with a p-value of 0.012, while no significant differences were found in the frequencies of nausea and vomiting. Additionally, in the periodic pain assessment, no remarkable difference was observed between the graphs of the STSA and GA groups.

Table 1: Demographic data

Variables	Group		p-value
	STSA	GA	
	(n=30)	(n=30)	
Age (years)	50.8± 9.1	51.2±8.7	0.863
BMI (Kg/m^2)	25.3±1.4	24.9±1.6	0.307
Physical status			
ASA I	9 (30%)	7 (23.3%)	0.158
ASA II	17 (57%)	18 (60%)	
ASA III	4 (13%)	5 (16.7%)	

Table 2: Effects of anesthesia

Variables	Group		p-value
	STSA	GA	
	(n=30)	(n=30)	
	Mean ±SD/n (%)		
Stay in the recovery room			
Minutes	119.8±41.2	218.3±50.4	<0.001
Patient satisfaction (score 0–10)			
Score	9.4±0.9	8.6±0.7	<0.001
Surgeon satisfaction (score 0–10)			
Score	9.5±0.7	8.9 ±0.7	0.002
Total opioid consumption (µg)			
Opioid	81.7±31.2	358.9±48.6	<0.001
Postoperative complications			
Nausea	3 (10.0%)	8 (26.7%)	0.181
Vomiting	4 (13.3%)	10 (33.3%)	0.125
UR	1 (3.3%)	9 (30.0%)	0.012

UR: Urine retention

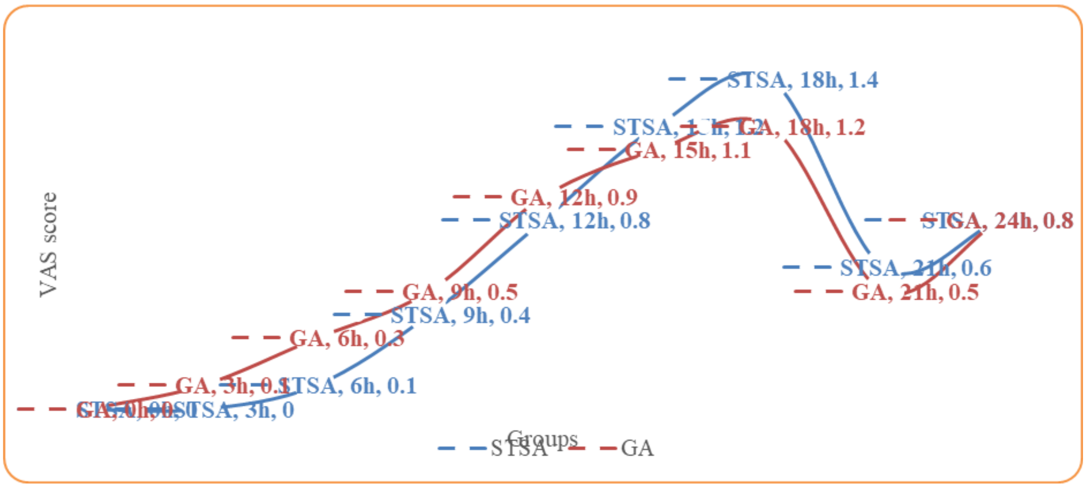

Figure 1: Periodic visual analog scale (VAS) score distribution

IV. Discussion

In this study, upon analyzing the demographic data, it was noted that the mean ±SD ages in the STSA and GA groups were 50.8 ± 9.1 and 51.2 ± 8.7 years, respectively, with mean ±SD BMIs of 25.3 ± 1.4 and 24.9 ± 1.6 Kg/m^2. No significant differences were found between the groups in terms of age or BMI ($p > 0.05$). This is consistent with the findings reported by Elakany et al. [15]. When comparing the ASA scores between the STSA and GA groups, the majority of participants in both groups were classified as ASA score II, followed by ASA score I and ASA score III. There were no significant differences between the groups in terms of ASA scores ($p > 0.05$), which aligns with the results of the previous study [15]. In this study, patients in the STSA group spent significantly less time in the recovery room compared to those in the GA group, with durations of 119.8 ± 41.2 minutes and 218.3 ± 50.4 minutes, respectively ($p < 0.001$), which is consistent with the results of a recent study [16]. When comparing patient and surgeon satisfaction scores between the STSA and GA groups, significant differences were observed, with p-values of < 0.001 and 0.002, respectively.Additionally, total opioid consumption (µg) was significantly lower in the STSA group than in the GA group ($p < 0.001$), which is in line with findings from another study [17]. In this current study, postoperative complications were analyzed, revealing a significant difference in urine retention frequency ($p = 0.012$), while no significant disparities were observed in nausea, vomiting, or periodic pain assessment between the STSA and GA groups. These results align with those reported by Mazy et al. [17]. Additionally, patients in the STSA group had shorter lengths of stay in both the recovery room and the hospital compared to the GA group, consistent with findings by Ellakamy et al. (2013) [18], who investigated recovery times in patients undergoing laparoscopic cholecystectomy under thoracic spinal anesthesia versus general anesthesia. Patients in the STSA group expressed high satisfaction with the anesthetic technique, attributing it to factors such as motor control of lower limbs, early mobilization, effective analgesia, and a low incidence of postoperative nausea and vomiting (PONV). These results mirror those reported by Ellakany et al. (2014) [19], who found thoracic spinal anesthesia to be safe for patients undergoing abdominal cancer surgery. The insights gained from this study could prove valuable for future research in similar contexts.

Limitation of the study:

The study's limited sample size and short duration may limit the generalizability of the findings beyond the specific context of the study. Thus, it is important to exercise caution when applying these results to the broader national or global context.

V. Conclusion

In breast cancer surgery, segmental thoracic spinal anesthesia exhibits superiority over general anesthesia, offering several notable advantages. Patients undergoing this technique typically experience shorter recovery times, attributed to reduced systemic effects and quicker return to baseline function. Moreover, both patients and surgeons report higher satisfaction scores due to improved intraoperative conditions and enhanced postoperative comfort. Importantly, segmental thoracic spinal anesthesia also correlates with fewer postoperative complications, further underscoring its efficacy and safety profile. This evidence highlights the potential of this approach to optimize surgical outcomes and enhance the overall patient experience in breast cancer surgery.

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