Section: Anaesthesiology

Original Research Article

HEMODYNAMIC CHANGES, POST-OPERATIVE OUTCOMES & PERFUSION INDEX VARIATIONS AFTER LAPAROSCOPIC SURGERIES UNDER SPINAL VERSUS GENERAL ANESTHESIA: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: General anesthesia (GA), the standard for laparoscopic surgeries, may induce hemodynamic instability due to pneumoperitoneum and mechanical ventilation. Thoracic segmental spinal anesthesia (TSSA) is emerging as a safer alternative. **Materials and Methods:** A prospective study was conducted on 100 patients undergoing laparoscopic surgeries under either GA or TSSA. Hemodynamic parameters and perfusion index (PI) were measured perioperatively. Adverse events were recorded. Data were analyzed using SPSS and GraphPad Prism. **Result:** TSSA showed significantly lower systolic and diastolic blood pressure fluctuations, fewer cases of hypertension, and a more stable perfusion index profile than GA. Postoperative pain and sore throat were significantly less in the TSSA group. **Conclusion:** TSSA offers better hemodynamic stability and postoperative outcomes compared to GA in laparoscopic surgeries.

INTRODUCTION

General anesthesia (GA) is widely used for laparoscopic surgeries but is associated with adverse hemodynamic fluctuations due to pneumoperitoneum, patient positioning, and airway manipulation. In contrast, thoracic segmental spinal anesthesia (TSSA) is gaining interest due to better hemodynamic control, reduced stress response, and avoidance of airway instrumentation.[1]

Pneumoperitoneum with carbon dioxide (CO_2) increases intra-abdominal pressure (IAP), induces a neuroendocrine response, and alters systemic vascular resistance. In GA, mechanical ventilation and airway interventions may exacerbate these effects. TSSA provides a segmental block with smaller doses of local anesthetic, preserving respiratory function and minimizing systemic side effects.[2]

Perfusion Index (PI), derived from pulse oximetry, is a non-invasive marker of peripheral perfusion. Anesthetic techniques influence PI through their effects on sympathetic tone. TSSA may stabilize PI and offer better tissue perfusion.[3,4]

This study aimed to compare intraoperative hemodynamic changes, PI trends, and postoperative adverse effects between TSSA and GA in laparoscopic surgeries.

MATERIALS AND METHODS

Study Design and Setting: A prospective, comparative cohort study conducted over one year at a tertiary care multispeciality hospital in the Department of Anaesthesiology.

Sample Size: 100 patients (50 in Group T – TSSA, 50 in Group G – GA).

Inclusion Criteria:

- Age 18–65 years
- Elective laparoscopic procedures
- ASA physical status I–III
- BMI 18–30 kg/m²

Exclusion Criteria:

- Contraindications to spinal anesthesia
- Severe cardiopulmonary comorbidities
- Prior abdominal surgeries

Ethical Consideration: This study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Monitoring and Data Collection: PI was continuously monitored. Hemodynamic parameters (SBP, DBP, HR) were recorded at baseline, during insufflation, post-insufflation, at exsufflation, and 10 minutes post-exsufflation. Adverse effects were noted.

Statistical Analysis: Data analyzed using SPSS v27 and GraphPad Prism v5. Continuous variables: mean ± SD; categorical variables: frequency and percentage. Independent t-test and chi-square tests applied; $p < 0.05$ significant.

RESULTS

Table 1: Demographic data

Variable	Group T (TSSA)	Group G (GA)	p-value
Age (years)	44.26 ± 14.26	43.26 ± 11.41	0.700
Gender (M/F)	31/09	40/10	0.523
Height (cm)	156.53 ± 9.31	155.44 ± 7.94	0.555
Weight (kg)	61.82 ± 8.96	62.06 ± 7.36	0.235
BMI (kg/m²)	23.55 ± 3.84	25.54 ± 3.23	0.312
Duration of Surgery (min)	38.48 ± 5.25	39.15 ± 4.28	0.122

Table 2: Hemodynamic parameters (SBP, DBP, HR)

Time point	SBP TSSA	SBP GA	p	DBP TSSA	DBP GA	p	HR TSSA	HR GA	p
Baseline	135.42 ± 17.28	128.72 ± 16.32	0.054	78.40 ± 20.75	81.10 ± 10.60	0.411	86.4 ± 10.2	85.6 ± 9.8	0.621
5 min insufflation	105.23 ± 18.04	122.38 ± 13.51	<0.001	63.88 ± 14.61	78.40 ± 7.92	<0.001	84.2 ± 9.5	92.8 ± 8.9	<0.001

Table 3: Adverse effects

Adverse effect	Group T (TSSA)	Group G (GA)	p-value
Hypotension	20 (40%)	5 (10%)	<0.001
Hypertension	2 (4%)	24 (48%)	<0.001
Postoperative pain (VAS>3)	8 (16%)	22 (44%)	0.002
Sore throat	0 (0%)	8 (16%)	0.010
Urinary retention	3 (6%)	2 (4%)	0.640

Table 4: Perfusion Index variability

Time point	PI TSSA	PI GA	p-value
Baseline	3.5 ± 0.8	3.4 ± 0.7	0.512
During insufflation	4.2 ± 0.9	2.8 ± 0.6	<0.001
End of surgery	4.0 ± 0.8	3.0 ± 0.7	<0.001
1 hr. postoperative	3.6 ± 0.7	3.1 ± 0.6	0.003

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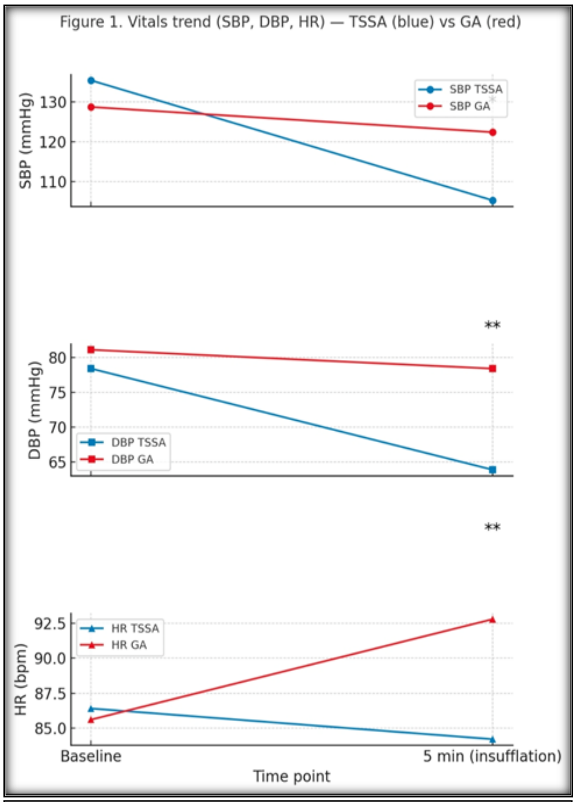

Figure 1. Vitals trend (SBP, DBP, HR) — TSSA (blue) vs GA (red)

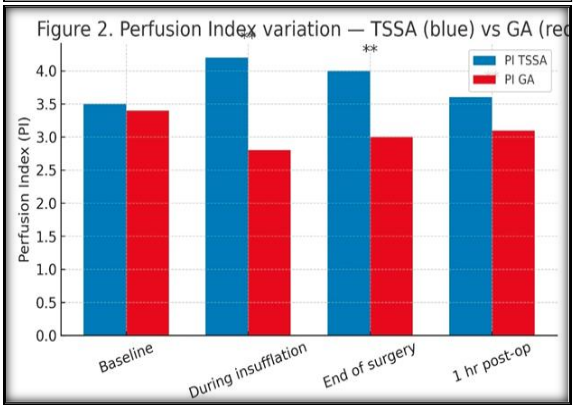

Figure 2. Perfusion Index variation — TSSA (blue) vs GA (red)

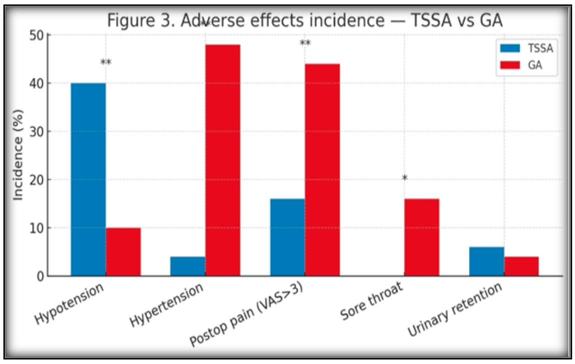

Figure 3. Adverse effects incidence — TSSA vs GA

DISCUSSION

The major purpose of this study was to compare hemodynamic parameters, namely heart rate, systolic blood pressure & diastolic blood pressure, mean blood pressure, perfusion index. Comparing thoracic segmental spinal anesthesia to general anesthesia, it was observed that the former had superior hemodynamic stability. Due to segmental block, group T saw a minor initial decrease in all three hemodynamic measures at five minutes. Anti-trendelenburg tilt and increased intra-abdominal pressure as a result of pneumoperitoneum contributed to this decrease even further. Forty percent of patients in group T experienced mild intraoperative hypotension, which was easily treated with modest boluses of mephentermine (6 mg) and crystalloid infusion. 10% of group T patients experienced bradycardia, which was quickly treated with 0.6 mg of atropine. In contrast to this group, G patients showed an increase in all three hemodynamic parameters during CO_2 insufflation, with 48% of patients meeting the criteria for intraoperative hypertension, which was treated with an extra fentanyl dosage.[5-7]

Comparing the postoperative and intraoperative adverse effects was our secondary goal. Only 8 out of 50 patients in group G experienced postoperative sore throats, one of the side effects of endotracheal intubation. Thirteen out of fifty patients in group G required rescue analgesics due to a considerably higher incidence of postoperative pain (> VAS 3) in the first six hours following surgery. None of the group T participants experienced any neurological negative effects following surgery. In the current study, the incidence of PONV, POUR, and shoulder tip pain was similar in both groups.[8]

In a group of twenty healthy individuals, Van Zundert et al. (2007) presented early data about the effectiveness of TSSA in LC with few side effects. Additionally, he mentioned that patients with comorbidities and those who are older may experience higher cardiovascular alterations.[8] While there have been several research comparing GA and spinal anesthesia in LC, there aren't many comparing TSSA and GA for LC.[9] TSSA and GA in LC situations were examined and contrasted by Ellakany (2013).[10] Paliwal et al. (2020) carried out a comparable analysis as well.[11] Our findings aligned with those of the two previous investigations. 18 individuals in Group G showed statistically significant hypertension ($p<0.001$).

In GA, hypertension is caused by both mechanical and neurohumoral factors. Abdominal distension reflexively raises systemic vascular resistance, and the peritoneal cavity's absorbed CO_2 stimulates the sympathetic nervous system.[12] The reversal of these carbo-pneumoperitoneum effects is responsible for the drop in systolic blood pressure following exsufflation. Heart rate increases to compensate for reduced cardiac output and venous return as well as sympathetic activation brought on by hypercarbia from CO_2 insufflation and the catecholamines that follow.[13]

In contrast, patients under TSSA exhibited higher hemodynamic stability because neuraxial anesthesia reduces the neuroendocrine stress response to surgery. Additionally, venous pooling in the hepatosplanchnic circulation is caused by sympathetic inhibition of the blocked segments (T4-L1), which prevents an increase in blood pressure.

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This spares the lower sympathetic segments and avoids an inflated hypotension. Furthermore, the TSSA group's lack of hypercarbia inhibits sympathetic activation, which promotes increased hemodynamic stability.[14] In TSSA, a normal increase in respiratory rate washes away the CO2 absorbed as a result of carboperitoneum while maintaining central respiratory control. The diaphragm, the primary inspiratory muscle, is innervated by the C3, C4, and C5 nerves; it is unaffected by TSSA, and expiratory breathing is a passive process.

The intercostal muscles of the occluded segments have motor blockage, which affects forced expiration and coughing. Because a low dose isobaric medication is being used in TSSA, this motor block is transient.[15] Previous research has found that a comparatively higher dose of local anesthetic may be harmful, especially in individuals with COPD whose lung ventilation depends on vigorous expiration.[16]

Limiting the IAP during surgery is crucial for LC in order to provide sufficient diaphragmatic excursions. Bradycardia can also result from vagal activation triggered by elevated intra-abdominal pressure. During surgery, the CO2 insufflation rate should not exceed 5–6 L/min and the IAP should be less than 14 mmHg with a somewhat limited anti-trendelenburg tilt.

CONCLUSION

TSSA offers improved hemodynamic stability, better perfusion index trends, and reduced postoperative complications compared to GA. It can be considered a viable alternative for selected laparoscopic procedures.

REFERENCES

1. Dorsay DA, Dillard TA, Watson JT, et al. Laparoscopic surgery: complications and lessons learned. Surg Endosc. 1995;9(2):128–133.
2. Van Zundert AA, Stultiens G, Jakimowicz JJ, et al. Continuous epidural analgesia for laparoscopic surgery: a practical approach. Br J Anaesth. 2006;96(4):464–466.
3. Geetanjali S, Singh R, Sharma A, et al. Comparison of intubating conditions with different doses of muscle relaxants. Indian J Clin Anaesth. 2022;10(1):3–10.
4. Hobaika AB. Laryngeal mask airway in difficult airway management. Acta Anaesthesiol Scand. 2007;51(6):783.
5. Krishnadas A, Mohan C, Rajeshwari S, et al. Hemodynamic response to laryngoscopy and intubation. Indian J Anaesth. 2016;60(11):827–832.
6. Anand VG, Bhatia N, Babu S, et al. Comparison of succinylcholine and rocuronium for rapid sequence induction. Indian J Anaesth. 2011;55(4):340–346.
7. Sharma B, Gupta P, Mehta R, et al. Hemodynamic effects of different induction agents in cardiac patients. Indian J Anaesth. 2016;60(6):403–408.
8. Van Zundert AA, Stultiens G, Kalkman CJ, et al. Low-dose rocuronium for tracheal intubation. Br J Anaesth. 2007;98(5):682–686.
9. Sinha R, Sharma B, Jindal P, et al. Use of succinylcholine and rocuronium in laparoscopic cholecystectomy. JSLS. 2008;12(2):133–138.
10. Ellakany M. Comparison of succinylcholine and rocuronium in rapid sequence induction. Egypt J Anaesth. 2013;29(4):375–381.
11. Paliwal NW, Gupta A, Soni S, et al. Intubating conditions with different doses of muscle relaxants. MedPulse Int J Anaesthesiol. 2020;14(3):77–83.
12. Chopra G, Gogia AR, Sharma S. Hemodynamic responses to endotracheal intubation. Internet J Anaesthesiol. 2007;16(1):1–7.
13. Berg K, Roed J, Brok J, et al. Rocuronium and succinylcholine for rapid sequence induction: a meta-analysis. Surg Endosc. 2004;18:1250–1256.
14. Korsten HH, Van Zundert AA, Stultiens G, et al. Intubating conditions after low-dose rocuronium. Br J Anaesth. 2006;98(5):682–686.
15. Sharma JP, Jain A, Kiran U, et al. Comparison of hemodynamic changes with different induction agents. Indian J Anaesth. 2008;52(5):587–592.
16. Wilhelm W, Hensel M, Möllhoff T, et al. Laparoscopic surgery: complications and hemodynamic changes. Surg Endosc. 1997;11:1210–1214.

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