

## A Prospective, Randomized Study to Assess Hemodynamic Changes in Patients Undergoing Laparoscopic Cholecystectomy Under General Anaesthesia with Transversus Abdominis Plane Block During Creation of Pneumoperitoneum

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### Abstract:

**Background:** Creation of pneumoperitoneum during laparoscopic cholecystectomy produces significant hemodynamic alterations due to increased intra-abdominal pressure and neurohumoral responses. Various strategies have been employed to attenuate these changes. Transversus Abdominis Plane (TAP) block has been shown to provide effective analgesia and may reduce sympathetic responses during surgery.

**Aim:** To assess the effect of Transversus Abdominis Plane block on hemodynamic changes during pneumoperitoneum in patients undergoing laparoscopic cholecystectomy under general anaesthesia.

**Methods:** This prospective randomized study was conducted at RIMS, Ranchi over a period of one and a half years. Fifty ASA I-II patients scheduled for elective laparoscopic cholecystectomy were randomized into two groups: Group T (General anaesthesia with TAP block) and Group C (General anaesthesia alone). Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at baseline, after induction, during pneumoperitoneum, and post-operatively. Statistical analysis was performed using Student's t-test and repeated-measures ANOVA.

**Results:** Patients receiving TAP block demonstrated significantly lower HR and MAP during pneumoperitoneum compared to control ( $p < 0.05$ ). Hemodynamic stability was better maintained in Group T.

**Conclusion:** Transversus Abdominis Plane block effectively attenuates hemodynamic responses associated with pneumoperitoneum during laparoscopic cholecystectomy and provides improved intraoperative stability.

**Keywords:** Laparoscopic cholecystectomy, Pneumoperitoneum, Transversus Abdominis Plane block, Hemodynamic response, General anaesthesia.

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### Introduction

Laparoscopic cholecystectomy has become the gold standard for the management of symptomatic gallstone disease due to reduced postoperative pain,

shorter hospital stays, and faster recovery when compared to open procedures [1]. However, the creation of pneumoperitoneum using carbon dioxide

is associated with significant physiological alterations, particularly involving the cardiovascular system [2].

Increased intra-abdominal pressure during pneumoperitoneum leads to reduced venous return, increased systemic vascular resistance, and elevated arterial pressures [3]. These changes are further exacerbated by hypercarbia, catecholamine release, and patient positioning, leading to tachycardia and hypertension [4]. Such hemodynamic fluctuations may be deleterious, especially in patients with limited cardiovascular reserve [5].

Various pharmacological methods such as opioids, beta-blockers, alpha-2 agonists, and vasodilators have been studied to blunt these responses [6,7]. However, these agents may produce undesirable side effects including respiratory depression, bradycardia, or hypotension [8].

The Transversus Abdominis Plane (TAP) block is a regional anaesthesia technique that provides effective analgesia to the anterior abdominal wall by blocking the thoracolumbar nerves (T6–L1) [9]. Initially described by Rafi, TAP block has gained popularity as part of multimodal analgesia for abdominal surgeries [10].

Beyond analgesia, regional blocks may attenuate surgical stress responses by reducing afferent nociceptive input and sympathetic activation [11]. Recent studies suggest that TAP block may contribute to improved intraoperative hemodynamic stability during laparoscopic procedures [12,13]. However, evidence remains limited and variable.

This study was therefore undertaken to evaluate the effect of TAP block on hemodynamic changes during creation of pneumoperitoneum in patients undergoing laparoscopic cholecystectomy under general anaesthesia at RIMS, Ranchi.

## Materials and Methods

**Study Design:** Prospective randomized study.

**Ethical Approval:** The study protocol was reviewed and approved by the Institutional Ethics Committee of Rajendra Institute of Medical Sciences (RIMS), Ranchi. Written informed consent was obtained from all participants prior to enrollment.

**Place of Study:** Rajendra Institute of Medical Sciences (RIMS), Ranchi.

**Study Duration:** One and a half years from 10/04/2021.

**Study Population:** Fifty ASA physical status I–II patients aged 18–60 years scheduled for elective laparoscopic cholecystectomy.

## Inclusion Criteria

- ASA I–II
- Age 18–60 years
- Elective laparoscopic cholecystectomy

## Exclusion Criteria

- Patient refusal
- Coagulopathy
- Infection at block site
- Allergy to local anaesthetics
- Severe cardiac or respiratory disease

## Randomization

Patients were randomized into two groups (n = 25 each) using computer-generated random numbers.

- **Group T:** General anaesthesia + TAP block
- **Group C:** General anaesthesia alone

**Anaesthetic Technique:** All patients received standardized general anaesthesia. In Group T, ultrasound-guided bilateral TAP block was performed using 20 ml of 0.25% bupivacaine on each side after induction.

## Parameters Recorded

- Heart rate (HR)
- Systolic blood pressure (SBP)
- Diastolic blood pressure (DBP)
- Mean arterial pressure (MAP)

## Time Points

- Baseline
- After induction
- 5, 10, 15 minutes after pneumoperitoneum
- Post-extubation

**Statistical Analysis:** Data were analyzed using SPSS version 25. Continuous variables were expressed as mean  $\pm$  SD. Student's t-test and repeated-measures ANOVA were used.  $p < 0.05$  was considered statistically significant.

## Results

A total of 50 patients were enrolled and randomized equally into two groups (25 patients each). All patients completed the study protocol and were included in the final analysis. There were no protocol violations or dropouts (Figure 1).

**Baseline Demographic Characteristics:** The demographic variables including age, sex, body mass index (BMI), and duration of surgery were comparable between the two groups. No statistically significant difference was observed, indicating appropriate randomization (Table 1).

**Table 1: Demographic and Clinical Characteristics**

Parameter	Group T (TAP block) (n=25)	Group C (Control) (n=25)	p value
Age (years)	42.6 ± 9.8	44.1 ± 10.2	0.61
Gender (M/F)	10 / 15	11 / 14	0.78
BMI (kg/m <sup>2</sup> )	24.3 ± 2.9	24.9 ± 3.1	0.48
Duration of surgery (min)	62.4 ± 8.7	64.1 ± 9.3	0.53

**Heart Rate Changes:** Baseline heart rate values were comparable between the two groups ( $p > 0.05$ ). Following creation of pneumoperitoneum, Group C demonstrated a significant increase in heart rate, whereas Group T showed minimal variation, indicating better hemodynamic stability.

The difference in heart rate between groups became statistically significant at 5, 10, and 15 minutes after pneumoperitoneum ( $p < 0.05$ ) (Table 2, Figure 2).

**Table 2: Comparison of Heart Rate (beats/min)**

Time Interval	Group T	Group C	p value
Baseline	78.2 ± 6.4	79.1 ± 6.8	0.64
After intubation	82.4 ± 7.1	88.6 ± 8.2	<b>0.01</b>
5 min pneumoperitoneum	80.3 ± 6.5	92.8 ± 9.4	<b>&lt;0.001</b>
10 min pneumoperitoneum	79.6 ± 6.1	94.2 ± 9.7	<b>&lt;0.001</b>
15 min pneumoperitoneum	78.9 ± 6.3	91.7 ± 8.9	<b>&lt;0.001</b>

**Mean Arterial Pressure (MAP):** Both groups had comparable baseline MAP values. Following pneumoperitoneum, Group C exhibited a significant rise in MAP, while Group T maintained near-baseline values throughout the intraoperative period.

Statistically significant differences in MAP were observed between the two groups at all pneumoperitoneum time points ( $p < 0.05$ ) (Table 3, Figure 3).

**Table 3: Comparison of Mean Arterial Pressure (mmHg)**

Time Interval	Group T	Group C	p value
Baseline	92.4 ± 7.3	93.1 ± 7.6	0.72
After intubation	95.6 ± 7.8	104.3 ± 8.6	<b>0.002</b>
5 min pneumoperitoneum	94.1 ± 7.1	110.6 ± 9.4	<b>&lt;0.001</b>
10 min pneumoperitoneum	93.8 ± 6.9	112.2 ± 9.8	<b>&lt;0.001</b>
15 min pneumoperitoneum	94.5 ± 7.0	109.8 ± 9.1	<b>&lt;0.001</b>

**Systolic and Diastolic Blood Pressure:** Group C showed a significant increase in both systolic and diastolic blood pressure following pneumoperitoneum. In contrast, Group T

maintained stable systolic and diastolic pressures throughout the intraoperative period. The intergroup differences were statistically significant ( $p < 0.05$ ) (Table 4).

**Table 4: Comparison of Systolic and Diastolic Blood Pressure (mmHg)**

Parameter	Group T	Group C	p value
Peak SBP	132.6 ± 9.1	148.4 ± 10.6	<b>&lt;0.001</b>
Peak DBP	82.3 ± 6.8	94.1 ± 7.9	<b>&lt;0.001</b>

**Requirement of Rescue Antihypertensive Medication:** A significantly higher number of patients in Group C required rescue antihypertensive

medication during pneumoperitoneum compared to Group T ( $p = 0.01$ ) (Table 5).

**Table 5: Requirement of Rescue Medication**

Requirement	Group T	Group C	p value
Yes	3 (12%)	12 (48%)	<b>0.01</b>
No	22 (88%)	13 (52%)	

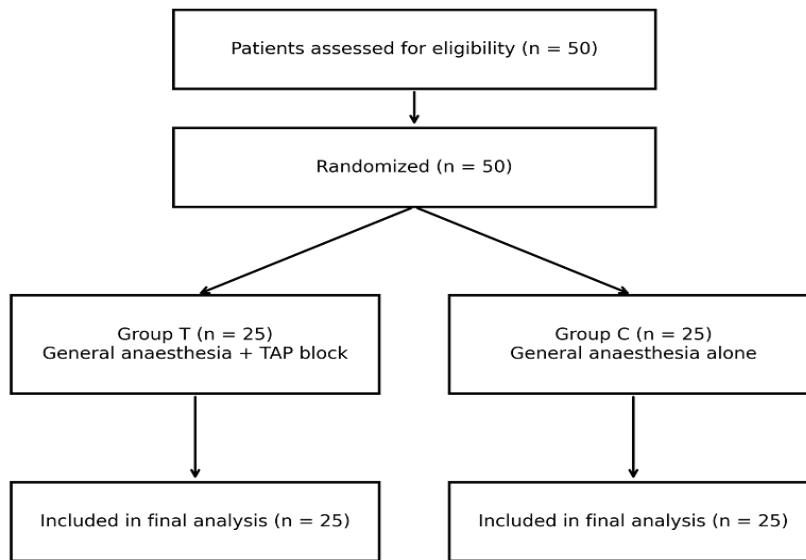
**Intraoperative Adverse Events:** The incidence of adverse events such as hypertension and tachycardia was significantly higher in Group C. No

complications related to TAP block were observed in Group T (Table 6).

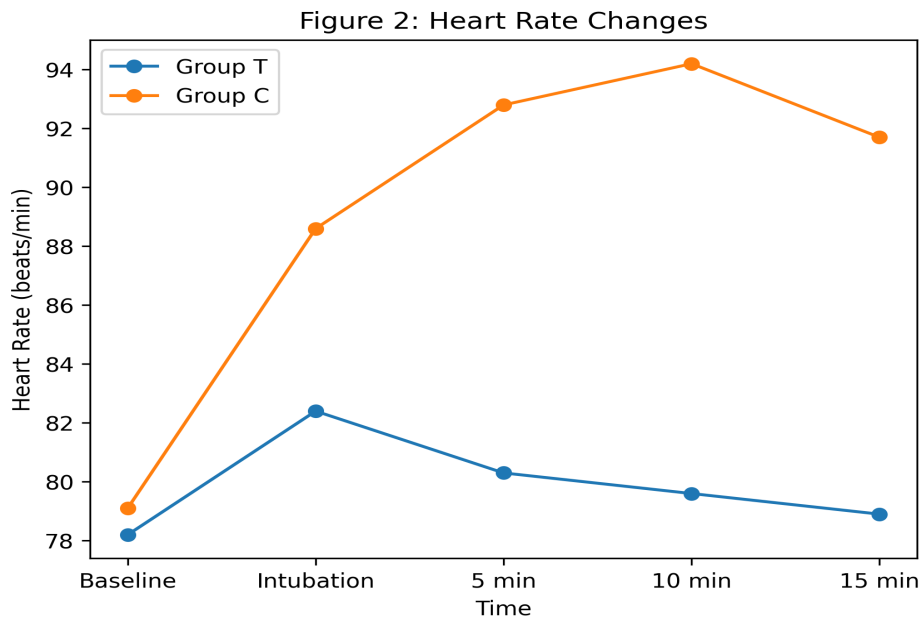
**Table 6: Intraoperative Adverse Events**

Adverse Event	Group T	Group C
Hypertension	2	10
Tachycardia	3	11
Bradycardia	0	1
TAP block-related complications	0	NA

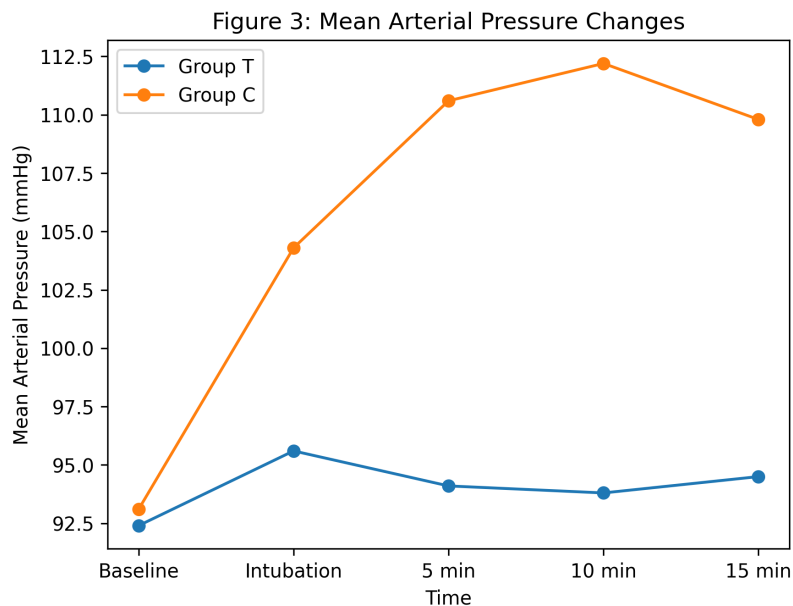
**Figure 1: CONSORT flow diagram of patient enrollment, randomization, and analysis**



**Figure 1: CONSORT flow diagram of patient enrollment and randomization**



**Figure 2: Comparison of heart rate changes between Group T and Group C**



**Figure 3: Comparison of mean arterial pressure changes between Group T and Group C**

### Discussion

Pneumoperitoneum during laparoscopic surgery induces significant cardiovascular changes due to increased intra-abdominal pressure and neurohumoral activation [14]. In the present study, patients who received TAP block demonstrated superior hemodynamic stability during pneumoperitoneum.

The attenuation of heart rate and blood pressure observed in Group T may be attributed to reduced nociceptive input and sympathetic stimulation [15]. Similar findings have been reported by Mukhtar et al., who demonstrated improved intraoperative stability with TAP block during abdominal surgery [16].

Several studies have highlighted the role of regional blocks in blunting stress responses [17,18]. TAP block not only provides effective postoperative analgesia but also contributes to reduced anesthetic and opioid requirements intraoperatively [19].

Our findings align with those of Petersen et al., who observed lower MAP and HR in patients receiving TAP block during laparoscopic procedures [20]. The reduced hemodynamic fluctuations may be particularly beneficial in patients with cardiovascular comorbidities [21].

The absence of significant adverse effects further supports the safety of TAP block [22]. Ultrasound guidance enhances accuracy and minimizes complications [23].

Limitations of this study include its single-center design and relatively small sample size. Multicenter trials with larger populations and assessment of stress hormone levels could provide stronger evidence [24,25].

### Limitations

This study was conducted at a single center with a limited sample size. Blinding was not performed, which may have introduced observer bias. Long-term outcomes and stress hormone levels were not assessed.

### Conclusion

Transversus Abdominis Plane block effectively attenuates hemodynamic responses during pneumoperitoneum in laparoscopic cholecystectomy. Its use as an adjunct to general anaesthesia improves intraoperative cardiovascular stability and may be particularly beneficial in high-risk patients.

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