Original Article

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Comparing Postoperative Analgesic Effect of Subcostal Transverse Abdominis Plane Block and Intraperitoneal Installation of Ropivacaine after Laparoscopic Cholecystectomy

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Abstract

Background: Laparoscopic cholecystectomy(LC) is a prevalent surgical procedure. A substantial portion of surgical pain originates from incisions of the abdominal wall, receiving sensory input from T6-L1 afferent nerves traversing the neurofascial plane between the internal oblique and transversus abdominis muscle. The subcostal transverse abdominis plane (TAP) block is effective for alleviating postoperative pain in upper abdominal surgeries. Hence, we aimed to assess postoperative analgesic effects of subcostal TAP block and intraperitoneal installation of ropivacaine after LC. **Subjects and Methods:** In this prospective comparative study, 54 patients were equally and randomly assigned to each group. Group I participants received 40ml of Intraperitoneal ropivacaine 0.25% instilled on the liver bed, while Group T participants underwent an ultrasound-guided subcostal TAP block with 40ml of ropivacaine 0.25%. Demographic and hemodynamic parameters were documented, and pain levels were evaluated using the Numerical Rating Scale (NRS) and Visual Analog Scores (VAS). Data regarding the need for rescue analgesia and the incidence of postoperative nausea and vomiting (PONV) were also recorded. **Results:** In the present study, no significant difference was noted in the demographical parameters. Haemodynamics were comparable among both groups. VAS scores were significantly lower in group T than I. In Group T, a significantly lower number of patients (n=9) needed rescue analgesia in comparison to Group I (n=23) (p=0.0001*). PONV was reported in 9 patients in Group I, whereas only 3 patients from Group T exhibited these symptoms (p=0.0495*). **Conclusion:** The ultrasound-guided subcostal TAP block is a highly effective adjunctive method in multimodal post-operative analgesic approach.

Keywords: Laparoscopic Cholecystectomy, Intraperitoneal Ropivacaine, Subcostal TAP block, Post-op pain.

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Introduction

Contemporary medical practice places a significant emphasis on managing postoperative pain, with various stratergies at our disposal, including systemic analgesia encompassing opioids and non-opioids, as well as neuraxial anaesthesia.[1] While opioid analgesics offer effective pain relief, their use is associated with undesirable side effects such as dizziness, respiratory depression, ileus, nausea, vomiting, and itching. Furthermore, achieving an optimal and stable dosage can be challenging. Consequently, regional analgesic techniques have garnered substantial attention in recent times.[2] Peripheral nerve blocks, a subtype of these techniques, have gained prominence due to their proven efficacy in alleviating postoperative pain and their favourable tolerability profile.[3] Adopting a multimodal analgesia approach, which combines ultrasound-guided regional blocks with non-steroidal anti-inflammatory drugs (NSAIDs), has emerged as a prominent strategy to enhance perioperative pain management.[4] In the context of post-laparoscopic cholecystectomy pain, a multifaceted challenge, multimodal analgesia has emerged as a recommended approach. Visceral pain primarily contributes to postoperative discomfort in LC, whereas somatic or visceral pain, remains a pertinent concern. This is particularly relevant given the modest size of abdominal incisions (1–4 cm) used for trocar placement and the limited trauma to the abdominal wall. Therefore, addressing somatic pain can be an integral component of multimodal analgesia, with the transversus abdominis plane (TAP) block representing an effective option. Ultrasound-guided (USG) TAP block, in particular, is a recommended method for managing postoperative pain, especially somatic pain within the abdominal region.[5,6] Numerous studies have showcased the effectiveness of TAP block in reducing postoperative pain scores and enhancing patient satisfaction.[6] This study aimed to compare the impact of Subcostal Transverse Abdominis Plane Block and Intraperitoneal installation using Ropivacaine after LC.

Subjects and Methods

This study was conducted at the Department of Anaesthesiology Shri Ram Murti Smarak Institute Of Medical Sciences, Bareilly (U.P.) and received approval from the ethical committee (SRMS IMS/ECC/2023/133). Informed written consent was obtained from 54 adult patients (27 in each group) classified as ASA I/II, aged between 18-60 years, scheduled for elective laparoscopic cholecystectomy. Exclusion criteria encompassed patients with allergies to local anaesthetic agents, skin conditions prohibiting the block, chronic opioid medication dependence, coagulopathy history, uncontrolled co-morbidities and those declining participation. The sample size of 54 (27 in each group). Patient and anaesthetist blinding were maintained during the study. Following patient transfer to the operation theatre, baseline vital signs were recorded, and premedication involved administering Inj Ondensetron 0.15mg/kg, Inj. Glycopyrrolate 0.05 mg/kg, Inj. Midazolam 0.5 mg/kg, and Inj. Fentanyl 2 mcg/kg, followed by 3 minutes of preoxygenation with 100% Oxygen. Both groups were induced with Inj. Propofol 2 mg/kg and Inj. Vecuronium 0.1 mg/kg, under direct laryngoscopy, and intubated using cuffed endotracheal tubes (7- or 7.5-mm ID for females, 8- or 8.5-mm ID for males) with tube placement after confirmation of bilateral air entry. Anaesthesia was maintained with an Oxygen/Air/Isoflurane. At the end of the surgery Group I, patients received Intraperitoneal ropivacaine 0.25% 40 ml on the liver bed, while Group T patients received an ultrasound-guided subcostal TAP block with ropivacaine 0.25% 40 ml. Both groups received an equal volume and dose of local anaesthetic. The subcostal TAP block was performed by using ultrasound guidance, while intraperitoneal infiltration was conducted by the surgeon. For the TAP block, the ultrasound probe was positioned midline on the abdomen, 2 cm below the xiphisternum, and moved laterally to the anterior axillary line, identifying the transversus abdominis muscle. A 100-mm, 22-G Stimuplex block needle was guided in-plane to a point just below the right costal margin at the anterior axillary line, positioning the tip between the transversus abdominis and internal oblique muscle within the neurovascular fascial plane. After aspiration, 0.25% ropivacaine was deposited within the plane. Postoperative intraperitoneal infiltration was performed in the standard manner using the same quantities and local anaesthetic dose. Patients were reversed using Inj Glycopyrolate+ Neostigmine 2.5mg/kg. Patients were transferred to the postoperative care unit. Patients received Inj. Paracetamol 1 gm, and Inj. Tramadol 50 mg was administered as rescue analgesia if needed. Outcome data were collected by another anaesthetist who remained blind to the individual patient's treatment group. Analgesia quality was assessed by comparing postoperative Visual Analog Scores (VAS).

Statistical Analysis

The data obtained from the study were subjected to statistical analysis using SPSS version 20.0 for further evaluation at the significance level of p-value=0.05. The data were presented as Mean ± standard deviation for continuous variables and frequency for categorical variables. Chi-square statistical analysis was done for categorical data, and for continuous data student's t-test were performed.

Results

The mean age of the patients in group T was higher [39.76±4.68 years] than in group I [37.21±5.65 years]. Female preponderance was noted in both groups. The mean weight was recorded higher in group I [61.38±3.42] than in group T [60.49±3.79], yet all the demographic parameters did not show any significant difference among groups. [Table-1] In Figure 1, our study revealed no statistically significant difference in heart rates between Group-I and Group-T at all intervals. As depicted in Figure 2, our findings indicate negligible alterations in MAP within both groups and these changes were consistent and similar across all time intervals examined. We observed significant changes in NRS and VAS among both groups from 2 to 24 hours. [Figures 3 and 4] In Group T, a significantly lower number of patients (n=9) necessitated rescue analgesia in comparison to Group I (n=23) (p=0.0001*). Notably, most patients in Group I sought rescue analgesia predominantly after 2 hours, followed by the 4-hour mark. In contrast, within Group T, a noteworthy observation was that most patients sought rescue analgesia after 12 hours (p=0.0116*). [Table-2] PONV were reported in 9 patients belonging to Group I, whereas only 3 patients from Group T exhibited these symptoms (p=0.0495*). [Figure-5].

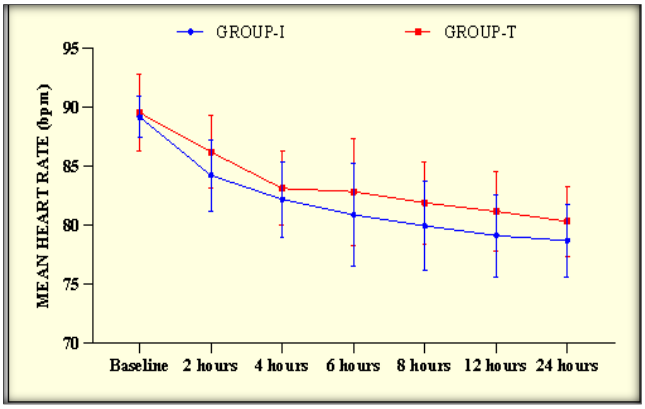

Figure 1: Comparison of Heart rate (bpm) of the patients among both groups

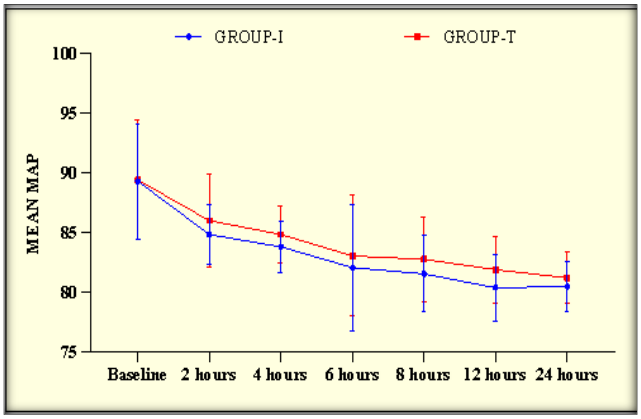

Figure 2: Comparison of Mean arterial pressure (mm Hg) of the patients among both groups

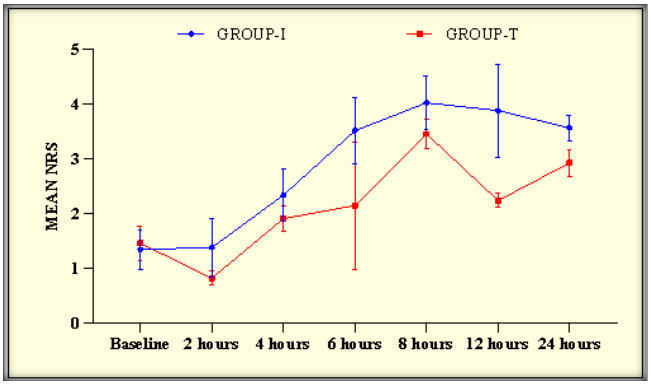

Figure 3: Comparison of the Numerical rating scale (NRS) of the patients among both groups

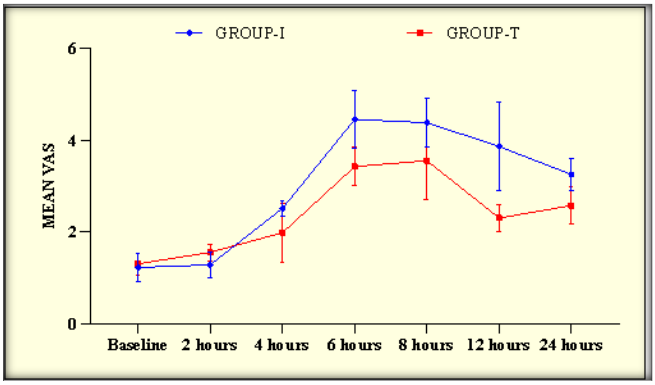

Figure 4: Comparison of Visual Analogue Scale (VAS) of the patients among both groups

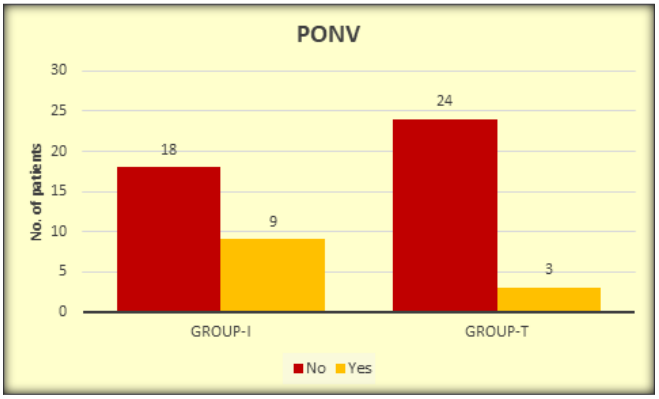

Figure 5: Comparison of incidence of postoperative nausea and vomiting (PONV) in patients among both groups

Table 1: Demographics of the patients among both groups (N=45)

Demographics		GROUP-I [n=27]		GROUP-T [n=27]		P-VALUE
		MEAN/ N	SD/%	MEAN/ N	SD/%	
AGE (Yrs)		37.21	5.65	39.76	4.68	t=1.806 p=0.0767
GENDER	MALE	12	44.44 %	10	37.04 %	X=0.3068 p=0.5796
	FEMALE	15	55.65 %	17	62.96 %	
WEIGHT (kg)		61.38	3.42	60.49	3.79	t=0.9059 p=0.3692

Table 2: Requirement of rescue analgesia in patients among both groups

RESCUE ANALGESIA	GROUP-I [n=27]		GROUP-T [n=27]		P-VALUE
	N	%	N	%	
No	4	14.81%	18	66.67%	X=15.03 **p=0.0001***
Yes	23	85.19%	9	33.33%	
30 min	4	14.81%	0	3.70%	X=12.93 **p=0.0116***
2nd hours	8	29.63%	0	3.70%	
4th hours	7	25.93%	2	7.41%	
8th hours	3	11.11%	3	7.41%	
12th hours	1	3.70%	4	11.11%	

Discussion

The Transversus Abdominis Plane (TAP) block has been established as an efficacious regional anaesthetic approach for diverse surgical procedures. Effective post-operative pain management not only minimizes morbidity rates but also mitigates the magnitude of the endocrine and metabolic responses triggered by surgery, ultimately hastening the recovery period.[8,9]

To mitigate the undesirable side effects of opioids, which can impede postoperative recovery and early discharge, opioid-sparing methods, including regional blocks, nonsteroidal anti-inflammatory drugs, dexmedetomidine, and ketamine, have been implemented in various surgical contexts.[10] Regional anaesthesia is a well-recognized and successful strategy for diminishing postoperative opioid requirements.[11]

In recent years, numerous studies have underscored the effectiveness of the TAP block in post-operative pain management when used in conjunction with general anaesthesia.[9] Laparoscopic cholecystectomy, a frequently performed outpatient procedure, is no exception. Postoperative pain and nausea/vomiting can prolong hospital stays following any surgery. Pain intensity tends to peak during the initial 24–48 hours, with incisional pain being a prominent component.[12]

Given that the TAP block delivers sensory analgesia spanning from T10 to L1 dermatomes, and the T10 dermatome consistently innervates the umbilicus, a bilateral TAP block is anticipated to provide substantial intra- and post-operative analgesia for laparoscopic cholecystectomy, potentially facilitating a swifter recovery.[11]

In our study, we found that hemodynamic parameters, including heart rate and mean arterial pressure, exhibited similar profiles in both study groups. This observation aligns with the findings of Nagappa S et al,[7] who also reported comparable hemodynamic parameters in their study. Pain following laparoscopic procedures typically stems from three sources: parietal pain attributed to the skin incision, visceral pain resulting from peritoneal inflammation, and shoulder pain arising from diaphragmatic irritation following pneumoperitoneum.[13,14]

However, it is worth noting that one of the limitations of the Transversus Abdominis Plane (TAP) block is its inability to effectively block visceral pain.[15] This is due to the fact that the TAP block administers local anaesthetics to the region between T6 and L1 spinal nerves, primarily responsible for somatic innervation of the anterior abdominal wall.[16,17] Our assessment of pain intensity using the Numerical Rating

Scale (NRS) and Visual Analog Scores (VAS) revealed that the mean NRS scores were higher in the subcostal TAP block group (Group I) compared to Group T at various time intervals from 2 to 24 hours postoperatively.

Additionally, the mean VAS score in our study was initially higher in Group T [1.56±0.18] at 2 hours compared to Group I [1.39±0.29]. However, from the 4-hour mark onwards, Group T exhibited a significant decrease in VAS scores compared to Group I. These findings are consistent with the study by Nagappa S et al,[7] where resting VAS scores and VAS scores during deep inspiration were notably lower in the subcostal TAP block group when compared to the intraperitoneal installation group.

Furthermore, a systematic review and meta-analysis conducted by Guo Q et al,[18] revealed that TAP block resulted in lower VAS pain scores at rest and during movement at 8 and 24 hours postoperatively. However, no significant difference was observed at the 1-hour mark compared to wound infiltration. These collective observations underscore the potential benefits of subcostal TAP block in enhancing postoperative pain management in laparoscopic cholecystectomy patients.

Our study reveals a notable extension in the duration of analgesia with subcostal Transversus Abdominis Plane (TAP) block compared to intraperitoneal installation. In Group T, a significantly smaller proportion of patients (n=9) required rescue analgesia in contrast to Group I (n=23) (p=0.0001*). Notably, most Group I patients sought rescue analgesia within 2 hours, whereas Group T patients predominantly required it after 12 hours (p=0.0116*). Consistent with our findings, Nagappa S et al,[7] also reported fewer patients requiring rescue analgesia in the subcostal TAP block group (12 patients) compared to the intraperitoneal installation group (23 patients)

Additionally, Petersen PL et al,[19] and others,[15] showed that patients receiving TAP block alongside a basic analgesic regimen after laparoscopic cholecystectomy experienced reduced pain scores while coughing and decreased morphine consumption in the initial 2 postoperative hours.

In our study, postoperative nausea and vomiting (PONV) were less frequently reported in Group T (3 patients) compared to Group I (9 patients) (p=0.0495*). Several prior studies have indicated that intraperitoneal installation primarily reduces immediate postoperative pain scores (in PACU) compared to TAP block.

Our findings align with previous studies showcasing the analgesic efficacy of TAP block, including reduced rescue analgesic requirements and lower pain scores.[7,15,19,20] Overall, Group T patients required significantly less rescue analgesia in the form of tramadol 50 mg compared to Group I, a pattern also observed by Nagappa S et al,[7] This underscores the superior postoperative analgesic quality associated with TAP block over intraperitoneal infiltration, consistent with a growing body of evidence. Furthermore, no serious complications were reported in either group, emphasizing the safety profile of the TAP block.

Our study results regarding postoperative nausea and vomiting align with most included studies, showing no statistically significant difference between TAP block and intraperitoneal installation.[7,19]

Conclusion

The ultrasound-guided subcostal TAP block emerges as a highly secure, straightforward, and remarkably efficient adjunctive method within the postoperative pain management protocol for patients undergoing laparoscopic cholecystectomy, particularly when juxtaposed with intraperitoneal installation. Moreover, it demonstrates significant efficacy in diminishing the need for rescue analgesia in elective laparoscopic cholecystectomy procedures, ultimately promoting enhanced recovery after surgery. Its limitation lies in its inability to address visceral pain. Future research should explore strategies for effectively managing visceral pain in conjunction with the TAP block to optimise its use, potentially enhancing overall postoperative recovery outcomes.

Conflict of Interest: All authors declare no conflict of interest.

Source of Funding: None.

Consent

As per university standards, the authors have collected and preserved written participant consent.

Ethical Approval

As per university standards, the author(s) has collected and preserved written ethical permission

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