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ORIGINAL ARTICLE

Laparoscopy Guided Bilateral Oblique Subcostal Transversus Abdominis Plane Block Using Ropivacaine for Postoperative Analgesia After Elective Laparoscopic Cholecystectomy: A Randomized Controlled Trial

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ABSTRACT

Context: Pain following laparoscopic cholecystectomy can adversely affect postoperative recovery and increase the need for analgesic medication. The transversus abdominis plane (TAP) block is a well-established regional anaesthetic technique for postoperative pain control. Performing the block under laparoscopic guidance offers a practical alternative to the conventional ultrasound-guided approach.

Aim: To assess the effectiveness of a laparoscopically guided bilateral oblique subcostal TAP block using 0.2% Ropivacaine in reducing postoperative pain in patients undergoing elective laparoscopic cholecystectomy.

Settings and Design: A prospective, double-blind, randomized controlled trial conducted at a tertiary care teaching hospital between July 2023 and March 2024.

Methods and Materials: Fifty patients aged 20–60 years who underwent elective laparoscopic cholecystectomy were randomly allocated into two equal groups (25 participants in each group). Patients in the intervention group received a laparoscopy guided bilateral oblique subcostal TAP block with 20 mL of 0.2% ropivacaine on each side, whereas those in the control group were managed with standard intravenous analgesia. Postoperative pain intensity was evaluated using the Visual Analogue Scale (VAS) at 6 hours, 12 hours, and at the time of discharge. The requirement for rescue analgesia was also documented.

Statistical Analysis: Data analysis was performed using IBM SPSS version 26.0. Continuous variables were analysed using the independent t-test or the Mann–Whitney U test, while categorical variables were compared using the Chi-

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square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

Results: Patients who received the TAP block had significantly lower postoperative VAS scores at 6 hours (4.6 vs. 5.8; p=0.007), 12 hours (2.9 vs. 4.0; p=0.001), and at discharge (1.6 vs. 2.6; p=0.001) compared with the control group. Additionally, 72% of patients in the TAP block group did not require any rescue analgesia.

Conclusion: Laparoscopy guided bilateral oblique subcostal TAP block using ropivacaine is a safe, feasible, and effective adjunct for postoperative pain management following elective laparoscopic cholecystectomy

KEYWORDS:

• Transversus Abdominis Plane Block • Oblique Subcostal TAP Block • Laparoscopic TAP Block • Postoperative Analgesia • Laparoscopic Cholecystectomy

INTRODUCTION

Postoperative pain is one of the most significant concerns for patients undergoing surgical procedures. Following surgery, a considerable proportion of the pain experienced originates from the abdominal wall incision. Even minor surgical procedures, such as inguinal hernia repair (herniorrhaphy or hernioplasty), can result in chronic postoperative pain in approximately 12% of patients if adequate pain management is not provided. Such persistent pain can have a substantial negative impact on patient's daily functioning and overall well-being.[1]

Poorly controlled postoperative pain adversely affects quality of life, delays functional recovery, increases the likelihood of postoperative complications, and contributes to the development of persistent postsurgical pain.[2] Conversely, effective pain management promotes faster recovery, shortens hospital stays, reduces healthcare costs, and improves patient satisfaction. Consequently, optimal postoperative pain control has become an important indicator of the quality of perioperative care and is closely monitored in clinical practice.[3]

The transversus abdominis plane (TAP) is a fascial plane in between the internal oblique and transversus abdominis muscle containing the thoracolumbar nerves from T6 to L1. By depositing local anaesthetic in this plane and thus blocking these nerves provides effective analgesia for upper abdominal procedures. The oblique subcostal TAP block in particular is performed along the subcostal margin, allowing for broader coverage of the upper abdominal wall. Reduced postoperative opioid analgesic requirements and patient reported pain scores have been demonstrated using the TAP block for various abdominal procedures including: laparoscopic cholecystectomy, upper abdominal laparotomies, bariatric surgeries, and total gastrectomy.[4,5,6]

Patients usually suffer significant pain after any abdominal surgery and the major source of pain being the anterior abdominal wall (the port sites) and the abdominal viscera.[7] Various LA agents have been utilised for post-operative analgesia using TAP block.[8,9,10]

Postoperative pain management is a crucial aspect of patient recovery following laparoscopic cholecystectomy. Despite being a minimally invasive procedure, laparoscopic cholecystectomy is associated with a significant postoperative pain due to peritoneal stretching, trocar insertion, and diaphragmatic irritation. Effective analgesia not only improves patient comfort but also facilitates early mobilization, reduces hospital stay, and minimizes the need for opioids, thereby reducing opioid-related adverse effects.

TAP block is a well-established regional anaesthesia technique that provides effective analgesia for abdominal surgeries. Among its variants, the subcostal TAP block targets the upper abdominal wall, making it particularly relevant for laparoscopic cholecystectomy, which primarily involves upper abdominal incisions. Traditionally, TAP blocks have been performed under ultrasound guidance; however, laparoscopy-guided administration offers a direct and precise approach, potentially improving efficacy and safety.

While existing studies have substantiated the analgesic benefits of TAP block, limited data is available on the effectiveness of the laparoscopy-guided subcostal TAP block in providing sustained postoperative analgesia at different time intervals until discharge. This study aims to bridge this knowledge gap by systematically evaluating the efficacy of this technique in patients undergoing elective laparoscopic cholecystectomy at Dr. LH Hiranandani Hospital, Powai. The findings from this research may contribute to optimizing postoperative pain management protocols, feasibility of performing a laparoscopy-guided subcostal TAP block in setups which do not have Ultrasonography (USG) machine in Operation Theatre (OT) and reducing reliance on systemic analgesics, ultimately enhancing patient outcomes and recovery.

MATERIALS AND METHODS

This is a double blinded randomised controlled trial which was conducted at the Department of General and Laparoscopic Surgery, Dr. L.H. Hiranandani Hospital, Mumbai, India from July 2023 to March 2024 after obtaining Institutional Ethics Committee (IEC) clearance (DHR-EC/NEW/INST/2020/1235). The study population comprised of patients undergoing elective laparoscopic cholecystectomy at the above-mentioned institute.

Inclusion Criteria:

- Patients undergoing elective laparoscopic cholecystectomy.
- Patients who provided written informed consent.
- Patients aged between 20 and 60 years.

Exclusion Criteria:

- Patients diagnosed with:
  (a) Acute cholecystitis, empyema, or gangrene of the gallbladder.
  (b) Choledocholithiasis or post-ERCP cases.
  (c) Diabetes, renal failure, or liver cirrhosis.
  (d) Use of immunosuppressants or chemotherapy.
- Patients who were converted to open cholecystectomy.
- Patients who underwent additional surgical procedures (e.g., hernia repair).
- Patients with a history of cardiac or respiratory diseases (ASA ≥ III).
- Patients who did not consent to participate in the study.
- Patients with prosthetic heart valves.
- Patients with a known allergy to amide local anaesthetics or medications included in the study.

STUDY PROCEDURE

The study commenced after obtaining IEC clearance, and appropriate written and informed consent was taken from all participants. Patient demographic details, including age, sex, occupation, socio-economic status, and address, were recorded. A detailed history, with a focus on the duration and characteristics of abdominal pain, dyspepsia, and past medical history, was obtained. A comprehensive general, abdominal, and systemic examination was performed. Preoperative workup, including complete blood count, blood sugar levels, blood urea, serum creatinine, liver function tests, hepatitis profile, chest X-ray, and abdominal ultrasound, was conducted. BMI and ASA scores were calculated.

Patients were allocated into two groups after randomization (using computerised method) as follows:

(a) Study Group (TAP Block +): Patients received bilateral subcostal TAP block.

(b) Control Group (TAP Block -): Patients did not receive bilateral subcostal TAP block but received intravenous analgesics.

In the study group, after the surgical steps were completed and before the release of pneumoperitoneum, subcostal TAP block was administered under direct laparoscopic visualization of the subcostal margin using the landmark technique. A 22-gauge needle was inserted bilaterally at the right and left subcostal regions, lateral to the rectus muscle. The needle was visualized laparoscopically, and once it was positioned at the fascial plane between the internal oblique and transversus abdominis muscles, 20 ml of 0.20% ropivacaine was injected bilaterally following negative aspiration. The successful administration of the TAP block was confirmed by the downward displacement of the transversus abdominis muscle away from the internal oblique upon injection (Doyle's bulge).

Postoperative pain scores were assessed at 6 hours, 12 hours, and at the time of discharge.

The pain scores were compared between the study and control groups to evaluate the effectiveness of the TAP block.

SAMPLE SIZE ESTIMATION

The sample size was estimated using nMaster Software Version 2.0 by applying the parameters from the study conducted by Nair P *et al.*, titled "*Efficacy and Cost-Effectiveness of Laparoscopic Transversus Abdominis Plane (TAP) Block in Laparoscopic Cholecystectomy: A Comparison with the Non-TAP Group*." In that study, the pain score after administration of rescue analgesics was 1.23 ± 1.00 in the TAP block group and 0.21 ± 0.64 in the non-TAP group. A statistically significant difference in the requirement for rescue analgesics was observed between the two groups ($p < 0.001$).

Using these parameters, with a two-sided alpha error of 0.05 and a study power of 99%, the sample size was calculated using the formula for comparison of two means. The estimated sample size was 25 participants per group.

STATISTICAL ANALYSIS

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (Armonk, NY: IBM Corp.), following initial data curation in Microsoft Excel 2016. Data summary was achieved via descriptive statistics. Specifically, continuous metrics were reported as mean ± standard deviation (SD), whereas categorical parameters were expressed as absolute frequencies and corresponding percentages.

Prior to comparative analysis, the distribution of continuous data was evaluated for normality. To compare two independent cohorts, the independent-samples t-test was utilized for Gaussian-distributed data, while the non-parametric Mann–Whitney U test was implemented for non-normally distributed variables. For categorical data, inter-group associations and differences in proportions were evaluated using either the Chi-square test or Fisher's exact test, depending on cell frequency requirements.

A two-tailed p-value of <0.05 was considered indicative of statistical significance for all comparisons.

ETHICAL CONSIDERATIONS

Prior to the initiation of the study, formal protocol review and ethical clearance were granted by the Institutional Ethics Committee (DHR-EC/NEW/INST/2020/1235). Informed written consent was obtained from all participants before including them in the study.

OUTCOME MEASURES

The primary outcome measure was the intensity of postoperative pain experienced by patient and was evaluated using the Visual Analog Scale (VAS) at 6 hours, 12 hours, and at discharge following the surgery.

Secondary outcome measures included the requirement for rescue analgesia, type of rescue analgesic administered, total postoperative analgesic consumption.

RESULTS

The majority of participants were in the 31–40 years age group (32.0%), followed by those aged 41–50 years (30.0%). Participants in the 51–60 years category accounted for 20.0%, while 14.0% belonged to the 21–30 years group. The least represented age group was up to 20 years, comprising only 4.0% of the total study population.

The distribution of age between the two groups did not show a statistically significant difference (p=0.388), indicating that both groups were comparable in terms of age distribution. Among the total 50 participants, 56.0% were female and 44.0% were male. In the Ropivacaine group, females constituted 64.0%, while in the Control group, they made up 48.0%. Males comprised 36.0% of the Ropivacaine group and 52.0% of the Control group. The difference in sex distribution between the two groups was not statistically significant (p=0.254). Among the total 50 participants, 16.0% had comorbidities, while 84.0% had none. In both the Ropivacaine and Control groups, the proportion of participants with comorbidities was equal at 16.0%, and those without comorbidities accounted for 84.0%. The statistical analysis using the Chi-Square test showed no significant difference between the groups (p=1.0). Among the total 50 participants, 96.0% were classified as ASA I, while 4.0% were classified as ASA II. In the Ropivacaine group, 92.0% of participants were ASA I, and 8.0% were ASA II, whereas all participants in the Control group (100.0%) were ASA I. The Chi-Square test did not show a statistically significant difference between the groups (p=0.490). A distribution of our patients and study groups based on their VAS scores at different time intervals is summarised (Tables 1 & 2).

Table 1: Distribution of patients based on VAS score at respective hours (n=50)

	Study Group				
	Ropivacaine (n = 25)		**Control** (n = 25)		**p value**
VAS score at 6 hours	**Median**	**IQR**	**Median**	**IQR**	
	4.0	2.5	6.0	2.0	0.007
	Study Group				
	Ropivacaine (n = 25)		**Control** (n = 25)		**p value**
VAS score at 12 hours	**Median**	**IQR**	**Median**	**IQR**	
	3.0	1.0	4.0	2.0	0.001
	Study Group				
	Ropivacaine (n = 25)		**Control** (n = 25)		**p value**
VAS score at discharge	**Median**	**IQR**	**Median**	**IQR**	
	2.0	1.0	3.0	1.0	0.001

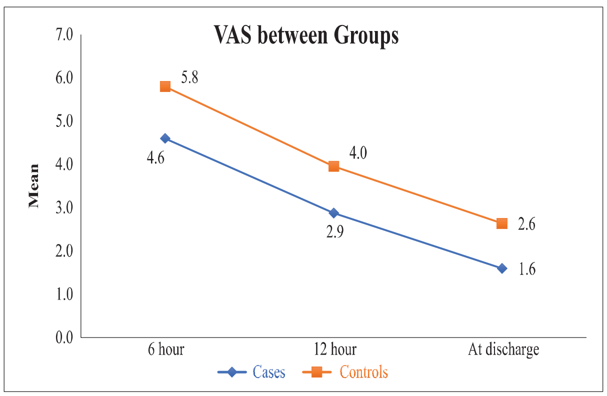

Figure 2: Distribution of study groups based on VAS score at different time intervals (n=50)

Table 3: Distribution of study groups based on rescue analgesic requirement (n=50)

Rescue Analgesic Requirement	TAP Block (+) (n=25)	TAP Block (-) (n=25)	p-value
No rescue analgesia, n (%)	18 (72.0%)	19 (76.0%)	
Rescue analgesia required, n (%)	7 (28.0%)	6 (24.0%)	
Paracetamol only, n (%)	4 (16.0%)	0 (0%)	0.75
Diclofenac only, n (%)	0 (0%)	6 (24.0%)	
Diclofenac + Paracetamol, n (%)	3 (12.0%)	0 (0%)	

The median VAS score in the Ropivacaine group at 6 hours was 4.0 (IQR: 2.5), whereas the median score in the Control group was higher at 6 (IQR: 2). The Mann-Whitney U test revealed a statistically significant difference between the groups (p = 0.007), indicating that patients in the Ropivacaine group experienced significantly lower pain levels compared to the Control group at 6 hours. The median VAS score in the Ropivacaine group at 12 hours was 3.0 (IQR: 1.0), while in the Control group, it was higher at 4.0 (IQR: 2.0). The Mann-Whitney U test demonstrated a statistically significant difference between the groups (p = 0.001), indicating that patients who received Ropivacaine experienced significantly lower pain levels compared to those in the Control group at 12 hours. The median VAS score in the Ropivacaine group at discharge was 2.0 (IQR: 1.0), whereas in the Control group, it was higher at 3.0 (IQR: 1.0). The difference between the groups was statistically significant (p = 0.001) as per the Mann-Whitney U test, suggesting that patients in the Ropivacaine group experienced significantly lower pain levels at discharge compared to those in the Control group.

Rescue analgesia was required in 7 patients (28.0%) in the TAP block group compared with 6 patients (24.0%) in the control group. The majority of patients in both groups did not require rescue analgesia (72.0% vs. 76.0%, respectively). Among 7 patients requiring rescue analgesia in the TAP block group, 4 (16.0%) received paracetamol alone and 3 (12.0%) required both diclofenac and paracetamol. In the control group, 6 patients (24.0%) required diclofenac as rescue analgesia. A distribution of our patients and study groups based on their requirement of rescue analgesic is summarised (Table 3). Comparison of overall rescue analgesic requirement between the two groups showed no statistically significant difference ($\chi^2 = 0.10$, $p = 0.75$)

DISCUSSION

The present study was undertaken with an aim to assess the effectiveness of Laparoscopy guided subcostal TAP block for post operative analgesia at different intervals of time till discharge in patients undergoing elective laparoscopic cholecystectomy in a tertiary care hospital in Mumbai, India. The present study included 50 participants, with the majority (62%) being between 31 and 50 years of age. The distribution of gender showed a higher proportion of females (56%) compared to males (44%). The participants were equally divided into two groups, Ropivacaine and Control, ensuring comparability across demographic characteristics such as age and gender, with no statistically significant differences between the groups ($p > 0.05$).

Comorbidities were present in 16% of participants, with equal distribution between the two groups ($p = 1.0$). The ASA classification indicated that most participants (96%) were classified as ASA I, with only 4% falling under ASA II. The distribution between groups was not statistically significant ($p = 0.490$), further supporting homogeneity between the study groups.

Pain assessment using the VAS demonstrated significantly lower pain scores in the Ropivacaine group compared to the Control group at all measured time points. At 6 hours postoperatively, the median VAS score was 4.0 (IQR: 2.5) in the Ropivacaine group versus 6.0 (IQR: 2.0) in the Control group, showing a statistically significant difference ($p = 0.007$). At 12 hours, the Ropivacaine group had a median VAS score of 3.0 (IQR: 1.0) compared to 4.0 (IQR: 2.0) in the Control group, with a highly significant difference ($p = 0.001$). Similarly, at discharge, the Ropivacaine group had a median VAS score of 2.0 (IQR: 1.0), which was significantly lower than the Control group's score of 3.0 (IQR: 1.0) ($p = 0.001$).

Rescue analgesia was required in 28.0% of patients in the TAP block group and 24.0% of patients in the control group. The difference was not statistically significant ($\chi^2 = 0.10$, $p = 0.75$), indicating comparable postoperative analgesic requirements between the two groups.

Current scientific consensus highlights the transversus abdominis plane (TAP) block as a highly effective element of multimodal pain management protocols following laparoscopic cholecystectomy.[11,12,13,14] The foundational technique was introduced in 2001 by Rafi *et al.*[15] via the lumbar triangle of Petit. This classic posterior approach relied on tactile feedback—specifically the "double-pop" sensation—and was primarily effective for surgeries involving the subumbilical abdomen. To mitigate the risk of localized procedural complications, Hebbard *et al.*[16] subsequently pioneered the ultrasound-guided methodology. This technological advancement allows clinicians to dynamically monitor needle placement, track local anesthetic distribution, and directly visualize target anatomical layers. For procedures requiring upper abdominal relief, the subcostal modification (OSTAP) serves as an alternative variant, offering dependable, unilateral supraumbilical analgesia.

Targeting the upper abdomen, the subcostal modification of the TAP block achieves its therapeutic effect by anesthetizing the anterior cutaneous branches of the T7 to T10 intercostal nerves.[17] Compelling evidence demonstrates that utilizing ultrasound guidance for this subcostal block significantly optimizes postoperative pain scores and reduces overall morphine requirements following laparoscopic cholecystectomy.[18] However, executing an ultrasound-guided block demands specialized technical proficiency that is not universally standard among anesthesia providers. Furthermore, the substantial financial burden of ultrasound equipment limits its availability in resource-constrained surgical centers. Consequently, leveraging the existing surgical laparoscope to facilitate the subcostal TAP block remains highly underutilized, despite a scarcity of literature confirming the clinical efficacy of this laparoscopic-guided approach.[19]

The first cholecystectomy was successfully performed by Dr. Carl Langenbuch in Germany in 1882. Subsequently, in 1985, Prof. Dr. Erich Mühe carried out the first laparoscopic cholecystectomy (LC).[20] Since its introduction, laparoscopic cholecystectomy has become the preferred technique for routine gallbladder removal and is now among the most frequently performed major abdominal surgeries in

Western countries.[21] As a minimally invasive procedure, LC offers several advantages over open cholecystectomy, including improved postoperative comfort, faster recovery, shorter hospital stays, superior cosmetic outcomes, lower rates of wound infection, and earlier mobilization. One of its most significant benefits is the reduction in postoperative pain compared with open surgery. Nevertheless, postoperative pain is not completely eliminated and remains clinically significant.[22]

Following laparoscopic cholecystectomy, patients commonly experience pain at the port sites, discomfort in the back, and referred pain in the shoulder region. Shoulder and subdiaphragmatic pain have been reported in approximately 12% to 60% of patients.[23] Pain intensity generally reaches its maximum during the initial postoperative hours and gradually decreases over the next 2–3 days.[24] Inadequately controlled postoperative pain can increase patient morbidity and is one of the major factors contributing to prolonged hospitalization after LC.

Postoperative pain following laparoscopic cholecystectomy is primarily attributed to the abdominal wall incisions created for trocar placement, while visceral pain resulting from peritoneal distension caused by pneumoperitoneum and residual intraperitoneal carbon dioxide contributes to a lesser extent. Systemic analgesics are routinely administered during the perioperative period to alleviate pain, attenuate the surgical stress response, facilitate early mobilisation, and reduce the incidence of complications such as atelectasis, hypoxaemia, and deep vein thrombosis. Therefore, adequate postoperative analgesia is essential for enhancing recovery and improving overall surgical outcomes.

Laparoscopic cholecystectomy is conventionally performed using a four-port technique, with trocar placement at the supraumbilical (10 mm), epigastric (10 mm), right anterior axillary (5 mm), and right midclavicular (5 mm) sites. The somatic sensory innervation of the anterior abdominal wall, encompassing the skin, musculature, and parietal peritoneum, is primarily derived from the thoracoabdominal nerves (T7–T11), the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1), with additional contributions from the upper lumbar spinal nerves. These neural structures course within the fascial plane between the internal oblique and transversus abdominis muscles. Consequently, deposition of local anaesthetic within this neurofascial plane provides effective blockade of the sensory nerves supplying the anterolateral abdominal wall, forming the anatomical basis of the transversus abdominis plane (TAP) block.

The subcostal transversus abdominis plane (SCTAP) block provides postoperative analgesia by blocking the anterior divisions of the thoracolumbar nerves supplying the upper anterior abdominal wall (T7–L1). To achieve effective bilateral analgesia, relatively large volumes of local anaesthetic are required to ensure adequate spread throughout the fascial plane. Typically, 15–20 mL of local anaesthetic is injected on each side to obtain satisfactory nerve blockade. Amide local anaesthetics, including lidocaine, bupivacaine, and ropivacaine, are the agents most frequently used for SCTAP blocks because they provide effective pain relief for approximately 6–8 hours without the routine need for adjuvant medications.

Although the extent of dermatomal spread following SCTAP block varies among individuals, consistent sensory blockade of the T10–T12 dermatomes is generally achieved within 30 minutes. Ropivacaine was selected for the present study because of its favourable safety profile and lower potential for cardiotoxicity and neurotoxicity compared with Bupivacaine. Its relatively low lipophilicity results in limited penetration of large myelinated motor fibres, thereby minimising motor blockade while preferentially inhibiting the smaller Aδ and C sensory fibres responsible for nociceptive transmission.

Following completion of the laparoscopic cholecystectomy, the needle was introduced under direct laparoscopic visualisation into the fascial plane between the internal oblique and transversus abdominis muscles. After careful negative aspiration, 20 mL of 0.2% ropivacaine was administered bilaterally using a 22-gauge long needle. Correct placement of the local anaesthetic was confirmed intraoperatively by the appearance of Doyle's internal bulge sign.

Postoperative pain intensity was assessed at predetermined time points, namely at 6 hours, 12 hours, and at hospital discharge. Pain scores between Group A and Group B were subsequently compared. Statistical analysis revealed significantly lower postoperative pain scores in Group A, which received a laparoscopic-guided bilateral SCTAP block, than in Group B, which received intravenous analgesics alone. Since laparoscopic cholecystectomy is routinely performed under general anaesthesia, the laparoscopic-guided SCTAP block can be administered conveniently during the procedure without increasing operative time, unlike ultrasound-guided techniques that require additional preparation and procedural time. Although all patients received the standard postoperative analgesic regimen, supplementary analgesia was required in both groups during the postoperative period.

A review of literature over the past 10 years on TAP blocks for laparoscopic surgeries is summarised (Table 4).

Table 4: Review of literature on TAP blocks for minimal invasive surgeries; over the past 10 years

Author/ Year	Sample Size / Population	Study Groups & Intervention	Local Anaesthetic / Technique	Key Outcomes	Main Conclusion
Breazu *et al*-**2016**[25]	60 patients, laparoscopic cholecystectomy	OSTAP + bupivacaine vs saline	0.25% bupivacaine	Decreased intra- & postoperative opioids; decreased pain; decreased PACU stay	OSTAP with bupivacaine improves analgesia
Khan et al-2016[26]	126 patients, laparoscopic cholecystectomy	UG posterior TAP vs subcostal TAP	0.375% bupivacaine (20 mL bilaterally)	30% posterior TAP needed rescue; none in subcostal TAP	Subcostal TAP superior
Ni ***et al*** **(Meta-analysis) -2017**[27]	19 RCTs, 1217 patients	TAP block vs control	0.375% & 0.5% ropivacaine	Decreased 24-h opioid use; decreased early pain; effect wanes by 12–24 h	TAP block effective early, limited duration
Sarvesh ***et al*****-2018**[28]	60 patients, laparoscopic cholecystectomy	Group R: ropivacaine vs Group RD: ropivacaine + dexmedetomidine	0.375% ropivacaine ± dexmedetomidine	Longer analgesia; decreased morphine in RD group	Dexmedetomidine prolongs TAP analgesia
Siriwardana ***et al*****-2019**[29]	Laparoscopic cholecystectomy	LG TAP block vs local infiltration	Laparoscopy-guided TAP	No analgesic benefit; possible increased pain	Ineffective due to improper plane and inexperience
Rajagopalan ***et al*****-2020**[30]	80 patients, laparoscopic cholecystectomy	Group U: US-guided TAP vs Group L: Lap-guided TAP	Subcostal TAP block	Higher success (100% vs 88%); longer analgesia; decreased morphine	US-guided TAP superior to Lap-guided TAP
Jung ***et al*****-2021**[31]	Elective laparoscopic cholecystectomy	BD-TAP + multimodal analgesia vs sham block	Ropivacaine	No difference in QoR-40 or pain at 24 h	BD-TAP did not improve recovery quality over control
Najar et al-2021[32]	60 patients, laparoscopic cholecystectomy	TAP block vs port-site infiltration	0.2% ropivacaine	Decreased pain scores, decreased opioid use, delayed first opioid	TAP block superior to port-site infiltration
Adam ***et al*****-2021**[33]	Minimally invasive colorectal surgery	Liposomal bupivacaine vs standard bupivacaine	Liposomal vs standard bupivacaine	No difference in opioids, pain, LOS	Liposomal bupivacaine offers no added benefit
Kadam ***et al*****-2021**[34]	Laparoscopic cholecystectomy	Subcostal TAP vs port-site infiltration	US-guided TAP	Longer analgesia; decreased tramadol; decreased NRS	TAP block superior to infiltration
Rouholamin ***et al*****-2022**[35]	200 women, laparoscopic gynaecologic surgery	TAP block vs GA alone	0.5% ropivacaine	Decreased pain up to 48 h; no decreased opioids or LOS	TAP block improves pain but no other outcomes
Jesmine ***et al*****-2023**[36]	71 patients, upper abdominal lap surgery	Bupivacaine vs Ropivacaine	0.25% bupivacaine vs 0.375% ropivacaine	Longer analgesia; decreased tramadol with ropivacaine	Ropivacaine superior to bupivacaine

table cont....

Author/ Year	Sample Size / Population	Study Groups & Intervention	Local Anaesthetic / Technique	Key Outcomes	Main Conclusion
Cho *et al*-2023[37]	Laparoscopic cholecystectomy	M-TAPA vs subcostal TAP	Modified TAP vs subcostal TAP	No difference in pain, PONV, satisfaction	Both techniques equivalent
Ishaque *et al*-2024[38]	100 patients, laparoscopic cholecystectomy	Group-A: LAP-assisted TAP block vs Group-B: placebo	0.5% ropivacaine	Lower pain scores at 2–24 h; reduced nalbuphine use	LAP-assisted TAP block reduces pain and opioid consumption
Singh *et al*-2024[39]	Laparoscopic surgery	TAP block vs intraperitoneal ropivacaine	Subcostal TAP	Decreased VAS; decreased rescue analgesia; decreased PONV	TAP block more effective than intraperitoneal LA

LIMITATIONS

The study was conducted at a single tertiary care hospital and the sample size is small which may limit the generalizability of the results to other populations and settings.

Although the VAS scale is widely used, pain perception is subjective and may be influenced by individual pain thresholds and psychological factors

Despite widespread use of TAP block in laparoscopic cholecystectomy, accurate identification of the transversus abdominis plane during bilateral subcostal laparoscopic TAP block remains technically challenging.

CONCLUSION

The findings of the present study indicate that laparoscopic-guided subcostal transversus abdominis plane (TAP) block using ropivacaine provides effective postoperative analgesia in patients undergoing elective laparoscopic cholecystectomy. Patients in the TAP block group consistently demonstrated significantly lower Visual Analogue Scale (VAS) pain scores at all evaluated postoperative time points compared with the control group, reflecting improved pain control and enhanced patient comfort. Furthermore, the procedure was performed safely under direct laparoscopic visualization without any significant complications, confirming its practicality and feasibility. Owing to its ability to provide sustained postoperative analgesia and its potential to decrease opioid requirements, the laparoscopic-guided subcostal TAP block represents a valuable component of multimodal analgesic protocols for laparoscopic cholecystectomy, particularly in operating theatres where ultrasonography facilities are not available.

Abbreviation	Expansion
CI	Confidence Interval
CNS	Central Nervous System
IEC	Institutional Ethics Committee
IQR	Inter Quartile Range
IV	Intravenous
NSAID	Non-Steroidal Anti Inflammatory Drugs
PACU	Post-Anaesthesia Care Unit
SD	Standard Deviation
TAP	Transversus Abdominis Plane
OSTAP	Oblique Subcostal Transversus Abdominis Plane
VAS	Visual Analogue Scale

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