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Original study

Comparison of modified thoracoabdominal nerve block through perichondral approach block with port site local infiltration for postoperative analgesia after laparoscopic cholecystectomy: a randomised controlled study

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Abstract

Background: The postoperative pain after laparoscopic cholecystectomy (LC) is a common concern.

Objectives: To compare the postoperative pain intensity in patients receiving port site local anesthetic (LA) infiltration and m-TAPA (modified thoracoabdominal nerve block through perichondral approach) block

Design: Randomized controlled study

Setting: Tertiary care teaching hospital

Methods: 46 adult patients were randomly allocated to receive LA infiltration in Group I (n=23) or m-TAPA block in Group II (n=23). The postoperative pain using the verbal numerical rating scale (NRS) at 0 (on transfer to postanaesthesia care unit) , 2, 4, 6,8,12 , and 24 hours (h) ,the proportion of patients requiring rescue analgesics, the time taken for the first request of rescue analgesic, and self -administered Quality of Recovery (QoR) at 24 h after surgery were noted.

Main Outcome Measures: NRS score at 24 hours after surgery and proportion of patients requiring rescue analgesia.

Results: The NRS score (on scale 0 to 10) was significantly higher in Group I compared to Group II at 0, 2, 4, 6, and 8 h after surgery. However, it was comparable in both groups at 24 h postoperatively (median NRS [interquartile range], Group I vs. Group II, 4.00 [3.96-4.82] vs. 4.00 [3.59-4.67], p=0.42). A lesser proportion of patients requested for rescue analgesia in Group II [patients requiring first: second: third rescue analgesics in number (percentage), Group I, 23(100):17(73.9):11(47.8) vs. Group II, 14(60.9):2(8.7):0, P<0.001). The time to request rescue analgesia was longer in Group II (median time 7 [4-8] h vs .2 [2-4] h, p<0.001).Additionally, the patient in Group II reported better postoperative QoR-15 score (Scale 0 to 150).

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Written Informed Consent: Written informed consent from the patients was obtained for participation in the study and the use of study data for research and educational purposes
Clinical Trial Registration: Clinical Trial Registry of India: CTRI/2023/07/055685
URL: https://ctri.nic.in/Clinicaltrials/regtrial.php?trialid=89303&EncHid=93241.27175&modid=1&compid=19
Institutional Research Board Approval: Copy pasted below
Name: "Institutional Ethics Committee" of Maulana Azad Medical College & Associated Hospitals, New Delhi
Address: Maulana Azad Medical College and Associated Hospitals, Bahadur Shah Zafar Marg, New Delhi-110002
Internal reference number of ethics committee:
CDSCO Registration No: ECR/329/Inst/DL/2013/RR 2024
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Member secretary of ethics committee: Dr. Shalini Chawla.

Conclusion: **In patients undergoing LC, the m-TAPA block provided better early postoperative analgesia and improved quality of recovery compared with port-site infiltration, although pain intensity was similar at 24 h.**

Trial registration: **CTRI/2023/07/055685**

Key words: **Cholecystectomy, laparoscopic, pain, postoperative, analgesia, anesthesia, local, injections, nerve blocks.**

Introduction

Postoperative pain after laparoscopic cholecystectomy (LC) remains a common concern[1]. The intensity of pain is maximal during the first 4-8 hours (h) and usually declines following 2-4 days. The origin of postoperative pain after LC is complex and arises from incisional, visceral, and referred components. The incisional pain component has been shown to dominate over the other pain components in intensity and severity in the immediate postoperative period[2]. A multimodal analgesic regime consisting of paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs) / cyclooxygenase-2 (COX-2) inhibitors, and dexamethasone, along with port-site local anaesthetic (LA) infiltration, has been recommended for postoperative pain after LC[3]. The LA infiltration of the port site is a simple and economical technique, however, the duration of analgesia is limited to 2-4 h only, and there may be an increased requirement of rescue analgesics in patients[4].

Ultrasound (USG) -guided fascial plane blocks such as transversus abdominis plane (TAP), quadratus lumborum (QL), and erector spinae plane (ESP,) are another options for pain management after LC. With the ubiquitous availability of USG machines in anaesthesiology practice, there is a promising role for these blocks in pain management. Thoracoabdominal nerves block through the perichondral approach (TAPA) is a new fascial plane block that was originally described with injections of LA to lower and upper aspects of the 9th and 10th costal cartilage[5]. Tulgar et al. recently described a modified TAPA (m-TAPA) technique in which an LA agent is applied only to the lower surface of the 10th costal cartilage, leading to blockade of both anterior and lateral cutaneous branches of thoracoabdominal nerves[6]. There is a paucity of studies comparing the m-TAPA block with port site LA infiltration for postoperative analgesia in patients undergoing LC. Hence, it is worthwhile to study the effect of m-TAPA block for postoperative analgesia and quality of recovery in LC patients compared to port site local infiltration. We hypothesise that m-TAPA block compared to infiltration of the surgical port site would result in better postoperative pain relief after LC. The primary objective of the study was to compare the postoperative pain intensity in patients receiving port-site LA infiltration and m-TAPA block with the numerical rating scale (NRS) for pain at 24 h after surgery and the proportion of patients requiring rescue analgesic drugs as the primary outcome variables. The secondary objectives were to compare the duration of analgesia, the amount of rescue analgesic drugs consumed, the common side effects associated with the use of opioids and the postoperative quality of recovery (QoR) in the patients.

Methods

We performed a prospective randomised controlled study. It was commenced after obtaining clearance from the Institutional Ethics Committee (Institutional Ethics Committee, Maulana Azad Medical College and associated hospitals, New Delhi -110002, Reference number; F.1/IEC/MAMC/MD/MS (96/02/2023)/No.101 dated 15/05/2023, Member Secretary; Dr. Shalini Chawla) and registration under the Clinical Trial Registry of India (CTRI/2023/07/055685). Written informed consent from the patients was obtained for participation in the study and the use of study data for research and educational purposes. The study was conducted by the principles of the Declaration of Helsinki, 2013, and Good Clinical Practice guidelines.

We included adult patients with ages between 18 and 65 years and those belonging to American Society of Anesthesiologists (ASA) physical status I to III undergoing LC under general anaesthesia (GA). Patients with pregnancy, a body mass index of more than 35 kgm^{-2}, or a known allergy to LA drugs were excluded from participation in the study.

Using a computer-generated random table with an allocation ratio of 1:1, patients were randomly allocated into one of the two groups: Group I (local infiltration group) or Group II (m-TAPA group). For concealing the group allocation, sequentially arranged white, opaque envelopes were used. On the day of the surgery, after the patient was moved into the operation theatre, the envelope containing the group allocation was

opened. The anaesthesiologist who performed the study intervention as per group allocation was not involved in the postoperative follow-up and assessment of patients. The anaesthesiologist who assessed the patients in the postoperative period for data collection was unaware of the group allocated to the patient and was not involved in the anaesthetic management. Hence, this study was assessor-blinded.

In Group I (port site filtration group), a total of 20 ml of 0.25% bupivacaine was infiltrated into the skin and subcutaneous tissues at the port sites after induction of anesthesia. In Group II (m-TAPA), ultrasound-guided m-TAPA was performed after induction of anaesthesia with the patient in the supine position. The block was performed by an anaesthesiologist who had experience of at least 20 m-TAPA blocks. Under all aseptic precautions, bilateral m-TAPA block was performed using a high-frequency USG probe (5-15 Hz). The USG probe was placed in the parasagittal orientation in the subcostal area, and the 10th costal cartilage and the muscles of the abdominal walls i.e., external oblique muscle (EOM), the internal oblique muscle (IOM) and the transversus abdominis muscle (TAM), were identified. An ultrasound needle (21 gauge, 75 mm) was inserted via an in-plane technique from the caudad to cephalad direction, and the needle tip was advanced in the plane of the ultrasound beam till it reached between the lower aspect of the 10th costal cartilage and the fascia superficial to the TAM. The correct positioning of the needle was confirmed by hydrodissection, and then, after negative aspiration, 20 ml of 0.25% bupivacaine was injected into the plane. The procedure was repeated on the other side.

Patients who were scheduled to undergo elective LC under GA were screened at the preanaesthetic check-up (PAC) clinic one or two days before surgery. The patients were familiarised with the usage of the verbal NRS, ranging from "0" (no pain) to "10" (worst pain imaginable), during the PAC visit.

On the day of surgery, standard monitors, including continuous electrocardiography (ECG), peripheral oxygen saturation, and non-invasive arterial blood pressure, were attached once the patient was shifted to the operation theatre (OT) table. Baseline vital parameters were noted. An intravenous (IV) access of 18 G was established on the dorsum of the non-dominant hand, and infusion of lactated Ringer solution was started. Monitoring for depth of anaesthesia using the bispectral index (BIS) and neuromuscular transmission monitoring using acceleromyography was initiated. Injection of 1 mg midazolam, and fentanyl at a dose of 2 μg kg-1 IV was given as premedication. For induction of anaesthesia, propofol 2-2.5 mg kg-1 IV was administered slowly. After loss of verbal response, check ventilation was done, followed by administration of IV rocuronium 0.6 mg kg^{-1}. Subsequently, intermittent positive pressure ventilation was done for three minutes with a gaseous mixture of 1-1.2% isoflurane in oxygen and nitrous oxide (50:50). After three minutes, an appropriately sized ProSeal laryngeal mask airway (LMA) was placed, and the patient was put on mechanical ventilation. Patients in both groups were given 4 mg of injection dexamethasone IV. After induction of anaesthesia, the patient was either given local infiltration at port sites or the m-TAPA block for postoperative analgesia as per their group allocation.

After this, the patient was handed over to the surgeons. A gaseous mixture of 1-1.2% isoflurane in oxygen and nitrous oxide (50:50) with a target BIS value of 40-60 was used for maintenance of anaesthesia. Intermittent boluses of rocuronium were guided by quantitative neuromuscular monitoring with acceleromyography. Additional fentanyl boluses (0.5 μg kg^{-1}) were given and recorded in the case of an increase in intraoperative mean arterial blood pressure or heart rate of more than 20% of baseline for longer than 5 minutes. The amount of fentanyl administered during surgery was noted. The LC was performed using the standard four-port technique. During the surgery the intra-abdominal pressure (IAP) was maintained in the range of 12-14 mm Hg. After the removal of the gall bladder, the peritoneal cavity was thoroughly irrigated with saline before closure.

Patients in both groups were given IV paracetamol 1g, 20-30 minutes before the completion of surgery. The residual neuromuscular blockade was reversed using IV glycopyrrolate and neostigmine. At a train of four (TOF) ratio of 0.9, ProSeal LMA was taken out and the patient was transferred to the post-anaesthesia care unit (PACU). Both groups received IV paracetamol 1g every eight hours for analgesia. Patients were assessed at 0 (arrival in PACU), 2, 4, 6, 12 and 24 h after surgery for postoperative pain, postoperative nausea and vomiting, (PONV), and for sedation and pruritus.

Pain assessment using the verbal NRS scale was done at rest and during movement by asking the patient to assume the left lateral position. If at any point in time, the NRS was >4, the patient was given slow IV tramadol 50 mg as the first rescue analgesic. If the patient still complained of pain (NRS >4) after 20-30 minutes of the first rescue analgesia, a second dose of tramadol 50 mg slow

IV was given (second rescue analgesic). If even after this the patient complained of pain (NRS>4), IV fentanyl 0.5 µg kg-1 body weight (third rescue analgesic) was administered. The dose of tramadol for rescue analgesia was not repeated until at least six hours had passed since the last dose. The time taken for the requirement of the first analgesia after the patient was shifted to PACU, the number of patients requiring rescue analgesics, and the consumption of tramadol and fentanyl in the first 24 h were noted.

Nausea was assessed using a patient-reported numerical rating scale (NRS) in which 0= no nausea and 10=nausea as bad as it could be. For assessment of vomiting, the number of times the patient vomited or retched in the last six hours was observed and recorded. Patients were given rescue antiemetics during active vomiting or with an NRS score of 4 and above. The rescue antiemetic drug was ondansetron 4 mg IV. The assessment of pruritus and sedation using the Pasero opioid-induced sedation scale (POSS) was also done at the above study intervals (Annexure I). At 24 h after surgery, the quality of recovery of the patient was assessed using the Hindi version of the Quality of Recovery -15 (QoR-15) scale, which was self-administered[7]. This scale has fifteen questions, assessing five domains of patient- reported health status; pain (questions 11 and 12), physical well-being (questions 1, 2, 3, 4, and 13), physical independence (questions 5 and 8), psychological support (questions 6 and 7), and emotional state (questions 9, 10, 14, and 15).8 The QoR-15 scale score ranges from 0 to 150, where a higher score indicates better postoperative quality of recovery.

The primary outcome of this study was the NRS score for pain at 24 h of LC at rest and on movement and the proportion of patients requiring rescue analgesia in the first 24 h after surgery. The secondary outcomes were NRS at 0, 2, 4, 6, 8, and 12 h after surgery at rest and on movement, time to request for first rescue analgesia, total consumption of opioids at 24 h postoperatively, number of patients reporting nausea, vomiting, sedation, and pruritus in the first 24 h after surgery, and QoR-15 score at 24 h postoperatively. The adverse events related to the m-TAPA block such as vascular puncture, haematoma formation or LA toxicity were recorded.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) program for Windows, version 25.0 (SPSS Inc., Chicago, Illinois, USA, 2017). The data was analysed using the per-protocol principle. For dealing with the missing data, pairwise deletion was opted. The normality of the data of the study was examined using the Kolmogorov-Smirnov test. Depending on their distribution, continuous variables were presented as mean (standard deviation) (95% confidence interval) or median [interquartile range] and were analysed using Student's t-test or the Mann-Whitney test. The categorical variables were presented as absolute numbers and percentages. The chi-square test was used for analysing the categorical variables. Using a linear mixed effects model for secondary analysis, we compared the NRS at rest and on movement between study groups at 0, 2, 6, 8, 12 and 24 h after surgery. For the model, the patients were considered as random effects, while the postoperative time intervals and study groups were designated as fixed effects.

As the primary outcome of the study involved three comparisons (24 h NRS at rest and on movement, proportion of patients requiring rescue analgesia at 24 h after surgery), the Bonferroni correction was considered to control the family-wise error rate. The adjusted p- value of 0.016 is considered statistically significant.

The sample size calculation was based on primary outcomes, pain scores assessed using NRS and the proportion of patients requiring rescue analgesia 24 h after surgery. With reference to a previous study, we assumed the clinically relevant minimum difference of 1 in pain score at any time point between the two groups[9]. The number of patients requiring rescue analgesia in this study was significantly lower in the m-TAPA group at all time intervals. In the control and the m-TAPA groups, 91.1% and 41.1% of patients respectively required rescue analgesia in 12-24 h after surgery. Thus, a sample size of 21 patients per group provided a 90% power for detecting a significant difference in the NRS score between the two groups at an alpha level of 0.05 with an effect size of 0.1. For estimating significant difference in the proportion of patients requiring rescue analgesia at a 0.05 significance level and 90% power, a sample size of 17 patients is required. Hence, we decided to include 21 patients per group for our study. Considering a 10% attrition rate, a total of 46 patients were taken for participation in the study.

Results

This study was conducted for one year, from August 2023 to July 2024. A total of 46 patients were enrolled for participation in this study. The intended intervention was received by all patients enrolled in the study, and there was no dropout (Figure 1). There were no missing values in the data collected. There was no significant difference between the study groups with regard to the age, gender, or body mass index (BMI) of patients, as shown in Table I. Intraoperative fentanyl consumption and

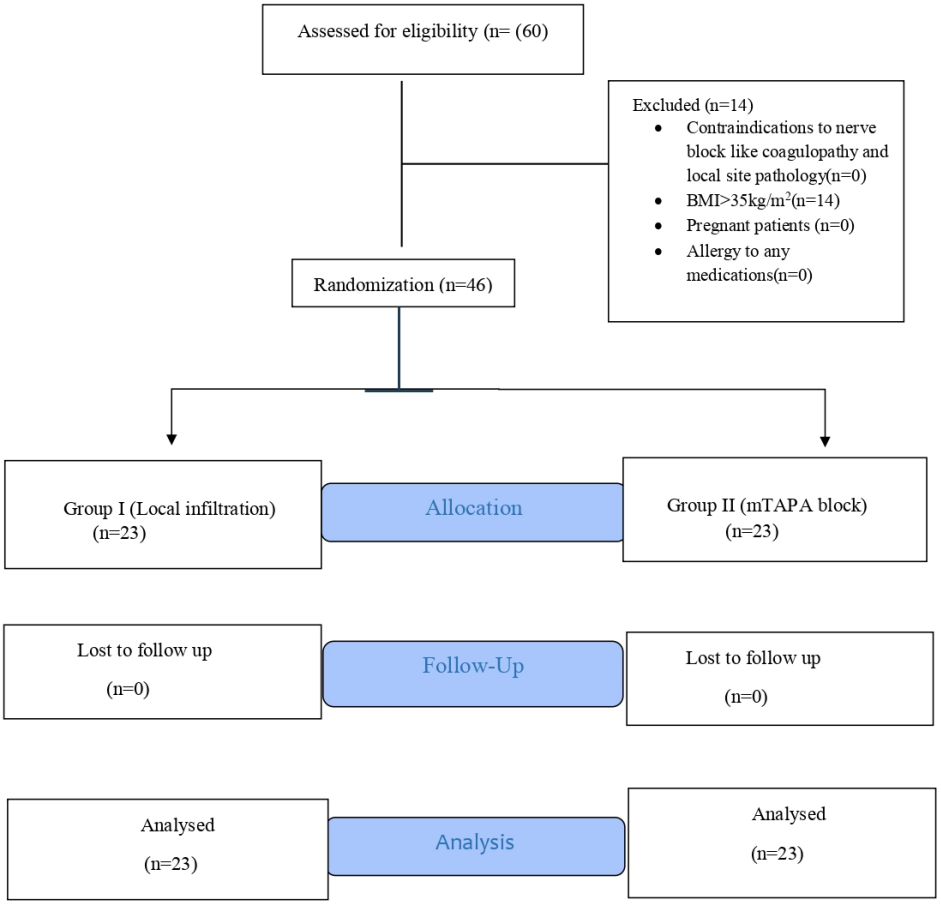

Fig. 1 — Consolidated Standards of Reporting Trials (CONSORT) diagram showing selection, randomization and analysis of patients.

Table I. — Comparison of demographic and baseline clinical characteristics of study groups.

	Group I (LA infiltration) (n=23)	Group II (mTAPA) (n=23)
Age (in years)*	38.17(11.56) (33.44, 42.89)	39.22(11.44)(34.54,43.89)
Gender** Male: Female	3(13):20(87)	4 (17.4):19(82.6)
BMI (in Kg/m²)*	27.11(4.18) (25.40,28.81)	25.71(3.80)(24.15,27.26)
ASA Grading** I:II	12(52.17) :11(47.82)	12(52.17) :11(47.82)
Duration of surgery€(in minutes)	90[75-100]	90[80-95]
Intraoperative fentanyl consumption (in µg)€	120[120-130]	120[120-140]

LA: Local Anaesthetic, m-TAPA: Modified Thoraco Abdominal nerve block through Perichondral Approach, BMI: Body Mass Index, ASA: American Society of Anesthesiologists.
Data expressed as *mean (standard deviation) (95% confidence interval), **number (%), € median [interquartile range].

the surgical duration were comparable between the groups.

The intensity of postoperative pain was measured on the NRS scale with a range from 0 to 10. It was found to be significantly lower in Group II compared to Group I at 0,2,4,6, and 8 h after surgery, both at rest and on movement (Figures 2 and 3). At 12 h postoperatively, the median NRS at rest was significantly lower in Group II (p=0.011), whereas the NRS on movement was comparable between the groups. The median NRS score at rest for postoperative pain at 24 h after surgery was comparable between the study groups (Group I, 4.00 [3.59-4.41] vs Group II, 4.00[3.38-4.36]; p=0.782). Similarly, there was no statistically significant difference in the median NRS on movement at 24 h in the two groups (Group I, 4.00 [3.96-4.82] vs Group II, 4.00[3.59-4.67]; p=0.423). In Group I, the median time for the first rescue analgesic request was 2 [2-4] hours after surgery, whereas in Group II it was needed after 7 [4-8] hours (P<0.001). There was a significant difference in the number of patients

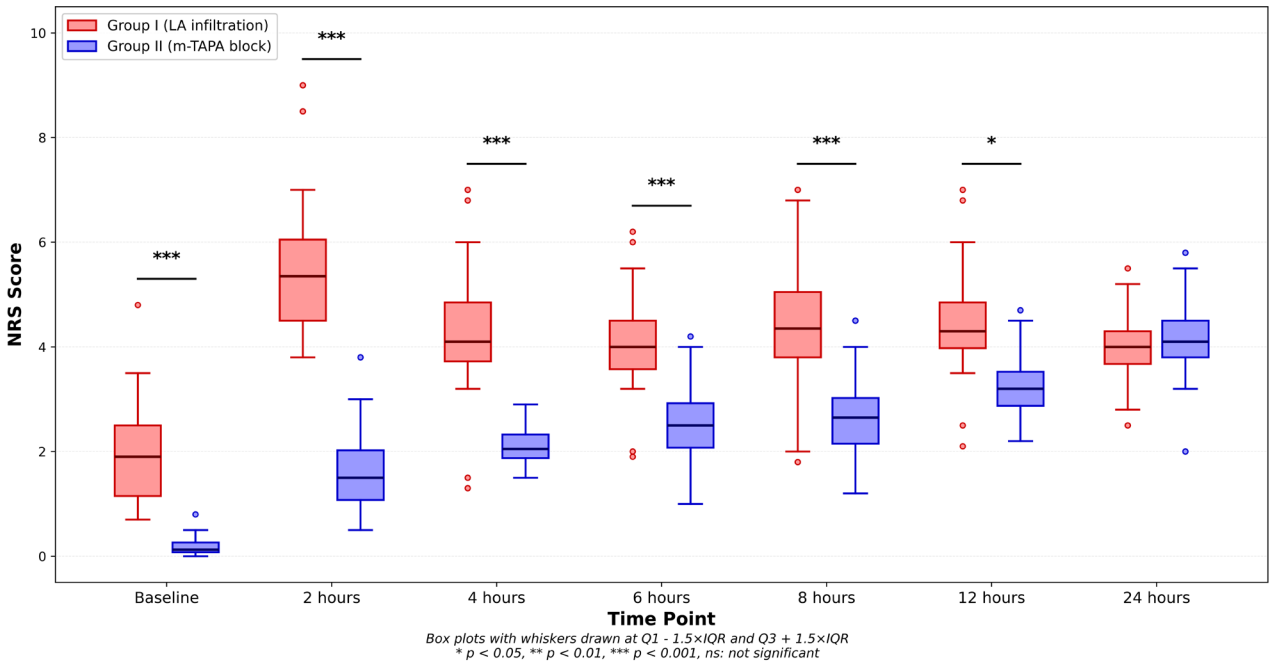

Fig. 2 — Comparison of Numeric Rating Score for Pain at rest at different postoperative study intervals.

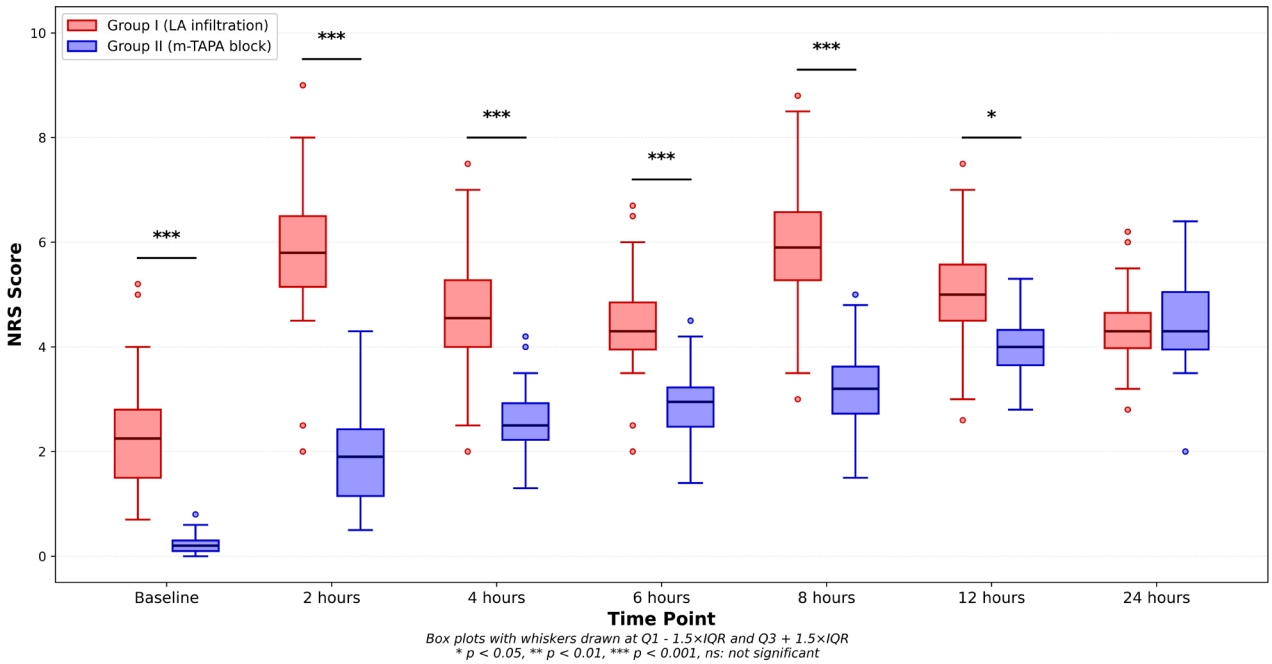

Fig. 3 — Comparison of Numeric Rating Score for Pain on movement at different postoperative study intervals.

requiring rescue analgesic medications between the groups, with a greater number of patients in Group I requiring additional drugs for pain relief (p<0.001). At 24 h after surgery, the consumption of fentanyl was higher in Group I, whereas the total dose of tramadol used was comparable.

The number of patients complaining of nausea and the NRS score (scale 0 to 10) for nausea were comparable in patients arriving at PACU (0 hours). Only one patient of Group II experienced vomiting at 0 hours. None of the patients complained of nausea or vomiting during other study periods. The POSS scores (scale S, 0 to 4) were comparable between the groups at the study intervals (Table II). There were no episodes of postoperative pruritus in any of the patients belonging to the study groups.

The patient-reported QoR-15 score (scale 0 to 150) at 24 hours after surgery was 118 [112-119] in Group I and 120 [119-121] in Group II (P=0.002). On the QoR-15 scale, the patients in Group II reported having moderate or severe pain less frequently in the first 24 h after surgery compared to Group I (p<0.001). Another domain of QoR-15,which was found to be better in Group

II, was the patient's reported ability to look after unaided personal hygiene (P=0.016). There was no significant difference in the remaining components of QoR-15 between the two groups (Supplementary material Table I). No complications related to the m-TAPA block were observed in the patients.

For the linear mixed model effect, logarithmic transformation of NRS scores was done, as these were observed to follow non-normal distribution. The estimated marginal means (statistically adjusted means, controlling the effects of other variables in the model) of the study group revealed a significant difference in the NRS score in the first eight hours postoperatively (Supplementary Material Table II). At 12 and 24 h after surgery, there was no difference in the postoperative NRS score for pain at rest (group time interaction effect at 12 h, p=0.078 and at 24 hours, p=0.725) and on movement (group time interaction effect at 12 h, p=0.198 and at 24 h=0.541).

Discussion

This present study found that m-TAPA block resulted in superior postoperative analgesia compared to LA infiltration in patients undergoing LC during the first 8 hours. The severity of the NRS score at 0, 2, 6, and 8 h at rest and on movement is significantly lower in patients receiving m-TAPA block compared to those receiving port site LA

Supplementary Table I. — Comparison of quality of recovery-15 scores between the study groups.

	QOR-15	Group I(LA infiltration)	Group II(mTAPA block)	P value
1.	Able to breathe easily	10[10-10]	10[10-10]	1.00
2.	Been able to enjoy food	1[1-1]	1[1-1]	0.317
3.	Feeling rested	10[8-10]	10[9-10]	0.627
4.	Have had a good sleep	10[9-10]	10[10-10]	0.464
5.	Able to look after personal toilet and hygiene unaided	0[0-0]	0[0-1]	0.016
	Able to communicate with family and friends	10[10-10]	10[10-10]	0.199
6.	Getting support from hospital doctors and nurses	10[10-10]	10[10-10]	1.00
	Able to return to work or usual home activities	0[0-0]	0[0-0]	0.317
7.	Feeling comfortable and in control	10[9-10]	10[10-10]	0.147
	Having a feeling of general wellbeing	10[9-10]	10[10-10]	0.107
8.	Moderate pain	9[7-10]	10[10-10]	0.001
	Severe pain	9[8-10]	10[10-10]	<0.001
9.	Nausea or vomiting	10[10-10]	10[10-10]	0.386
	Feeling worried or anxious	10[9-10]	10[9-10]	0.559
10.	Feeling sad or depressed	10[10-10]	10[10-10]	1.000
	Total score	118[112-119]	120[119-121]	0.002

LA: Local Anaesthetic, m-TAPA: Modified Thoraco Abdominal nerve block through Perichondral Approach.QoR: Quality of Recovery.

Supplementary Table II. — Mixed effect model for NRS at rest and on movement* between the study groups in the first 24 hours postoperative time points.

Postoperative time points	Group I(LA infiltration)	Group II (mTAPA block)	P value
	Estimate (95% CI)	Estimate (95% CI)	
NRS at rest			
Baseline (PACU arrival)	0.39(0.24-0.37)	0.02(-0.04-0.09)	<0.001
2 hours	0.78(0.66-0.79)	0.31(0.24-0.37)	<0.001
4 hours	0.69(0.62-0.75)	0.49(0.43-0.56)	<0.001
6 hours	0.69(0.62-0.75)	0.52(0.46-0.59)	<0.001
8 hours	0.71(0.64-0.77)	0.57(0.50-0.63)	0.003
12 hours	0.72(0.66-0.79)	0.64(0.58-0.71)	0.078
24 hours	0.69(0.63-0.76)	0.68(0.61-0.74)	0.725
NRS on movement			
Baseline	0.32(0.26-0.38)	0.02(-0.04-0.08)	<0.001
2 hours	0.79(0.72-0.85)	0.33(0.27-0.39)	<0.001
4 hours	0.74(0.68-0.81)	0.56(0.50-0.62)	<0.001
6 hours	0.72(0.65-0.78)	0.59(0.53-0.65)	0.006
8 hours	0.82(0.76-0.89)	0.61(0.55-0.65)	<0.001
12 hours	0.77(0.71-0.83)	0.71(0.65-0.77)	0.198
24 hours	0.72(0.66-0.79)	0.70(0.64-0.76)	0.541

*Logarithmic NRS.

infiltration. However, the NRS for pain was comparable at 12 and 24 h after surgery between the groups. This could be attributed to greater consumption of analgesic medications by patients of Group I (LA infiltration), the gradual wear-off of the effect of the LA drug, and the decrease in the intensity of postoperative pain with time. The duration of analgesia provided by the m-TAPA block is longer than LA infiltration, as indicated by the longer time to first request for rescue analgesia. The findings of this study are consistent with results by Bilge et al. and Güngör et al.[9,10]. Therefore, our study adds to the growing evidence that m-TAPA block can be an effective postoperative analgesia technique in patients undergoing LC with the standard four-port technique.

In the first 48 h after LC, it has been reported that the somatic pain is more intense compared to the visceral pain, and both m-TAPA and LA infiltration target this component of postoperative pain. The PROSPECT (PROcedure SPECific Treatment) guideline recommends port-site LA infiltration as a part of multimodal analgesia after LC. The regional nerve blocks are recommended in specific situations such as redo surgery, patients with chronic pain, etc. The infiltration of LA agents at the port site is a simple, rapid, and economical way of postoperative analgesia. It acts by blocking the transmission of pain signals through Aδ and C fibres. It has been reported that the reduction in postoperative pain and opioid consumption following LC was greater when LA agents were infiltrated before surgery. 11 However, the duration of analgesia provided is short, lasting only for 2-3 h. We observed in Group I (LA infiltration) patients that the NRS score was ≥4 right from 2 h onwards following surgery, and the median time to request rescue analgesia was approximately 2 [2-4] hours. On the other hand, the time to request for analgesia was 7 [4-8] hours in Group II (m-TAPA). The requirement of tramadol and fentanyl as rescue analgesics was greater in Group I. Therefore, the m-TAPA block has the advantages of providing postoperative pain relief for a longer duration after surgery and decreasing the requirement of opioid medications.

The m-TAPA block is essentially an approach to the TAP (Transversus Abdominis Plane) block where the LA drugs are injected between the lower margin of the 10th costal cartilage and the transversus abdominis muscle. Therefore, it has been speculated that m-TAPA, compared to the TAP block, covers the incision present in the lateral abdominal wall by blocking the lateral cutaneous branches in addition to the anterior cutaneous nerves. We used 20 ml of 0.25% bupivacaine each side for the m-TAPA block in Group II based on the study by Gungor et al.[10] The volume of LA used for the m-TAPA has been reported in the studies to vary from 15 ml to 30ml per side[12]. The number of dermatomes anaesthetized by the m-TAPA block depends on multiple factors including the volume of LA injected[13]. The initial clinical studies on the m-TAPA block that evaluated dermatomes using the pinprick test postoperatively in the patients reported that it anaesthetized the areas supplied by the anterior and the lateral cutaneous branch. Tanaka et al reported that m-TAPA block with 30 ml of LA solution resulted in loss of sensation in the anterior cutaneous branch area with the median number [interquartile range] of 6 dermatomes [5-7] at 2 hours and 6.5[5-7] at 24 hours. In the lateral cutaneous branch area the median number of dermatomes affected at these postoperative time points are 5[4-7] and 7[5-7] respectively. They reported 85% chances of simultaneously achieving complete analgesia in areas innervated by T8-11[14]. In another study performed by Aikawa et al, following m-TAPA block with 25 ml per side, the median number of blocked dermatomes was found to be 5 [7-4] in the anterior and 4 [5-2] in the lateral area. The highest sensory block was T7 [T5-8] and T9 [T7-T10] respectively in the areas innervated by anterior and lateral cutaneous nerves[15]. However, in these studies the dermatomal sensation was checked in the postoperative period where the residual effect of opioids received by the patients could have influenced the results. In a proof of concept pilot study that included healthy volunteers, bilateral m-TAPA block with 20 ml of ropivacaine, it was observed that the loss of sensation was restricted to area innervated by the anterior cutaneous branch especially in T7-11.There was no anaesthesia in the regions innervated by the lateral cutaneous area[16]. In the light of the results of this study, there seems no added advantage of the m-TAPA block over the TAP block. This has been corroborated by the findings of the recent clinical studies comparing the m-TAPA block with the subcostal TAP block[17,18]. Both blocks differ in the technique and the trajectory of needle used however they deposit the LA drugs in the same plane.Compared to other peripheral nerve blocks used to alleviate postoperative pain after LC, such as the ESP and QL blocks, the m-TAPA block does not necessitate the position of the patient to be changed and hence is less time-consuming.

The postoperative analgesic regime consisted of IV paracetamol 1 g every eight hours with IV tramadol 50 mg as the first and second rescue analgesic, followed by IV fentanyl as the third rescue. The analgesic effects of IV paracetamol 1 g start within half an hour and last 6 to 8 h.19 The frequency of administration can vary and a

6-h-interval approach is common. The PROSPECT working group recommends giving paracetamol and NSAIDs to decrease postoperative pain after laparoscopic cholecystectomy. In the present study we used IV paracetamol in the study groups for postoperative analgesia, however, NSAIDs were not used in the analgesic regime. This could have potentially exaggerated the benefit of the m-TAPA block over the port site local infiltration. Hence, a postoperative analgesic regime with a lower total paracetamol dosage and omission of NSAIDs is an important caveat of the present study.

We used IV tramadol for rescue analgesia in the present study. Tramadol is commonly used for postoperative analgesia in low - and middle-income countries (LMICs)[20]. The factors driving the use of tramadol in LMICs are its low cost, less restrictive regulation, and fewer side effects compared to strong opioids. Nevertheless, tramadol can be associated with side effects such as sedation, PONV etc., and has a ceiling effect for its analgesic properties. In our study, the rescue doses of tramadol were not repeated before 6 h, and hence the total dose did not exceed the maximum recommended daily dose of 400 mg.

The overnight observation of patients on the first postoperative day is an ingrained, conventional approach in many centres in developing countries, including ours. The patients are closely monitored in a dedicated postoperative ward and are generally given parenteral analgesics for pain relief. In line with this, the patients in the present study were given parenteral analgesic medications in the PACU and the postoperative ward.

We acknowledge that there are certain limitations of the present study. It was a single-centre study performed in a tertiary care hospital. The assessment of dermatomes blocked by the m-TAPA block was not done. There are various techniques of port site LA infiltration described for postoperative analgesia, such as infiltration of the rectus sheath in the infraumbilical incision, use of a continuous catheter, or liposomal bupivacaine. In this study we infiltrated the skin and subcutaneous tissues at the port sites before the surgical incision with LA agents; it is plausible that other techniques of infiltration could have different results. Also, we included only those patients who underwent LC with the four-port technique; the utility of m-TAPA in patients undergoing surgery via other newer techniques may require future studies.

Conclusion

In patients undergoing LC, the m-TAPA block provided better early postoperative analgesia and improved quality of recovery compared with port-site infiltration, although pain intensity was similar at 24 h. Further large, multicentre studies with fully standardised postoperative multimodal analgesia are required to confirm the findings.

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