Tokai J Exp Clin Med., Vol. 50, No. 3, pp. 75-80, 2025

Comparison of M-TAPA and EOIB to TAP Block in Laparoscopic Cholecystectomy: A Single-Blind Randomized Controlled Trial

Hideki MATSUURA[*1, *2], Yuki TERADA[*1, *2], Nobuhiro TANAKA[*1], Yuki ROKKAKU[*2], Tomoki ISHIKAWA[*2], Naoki OZU[*3] and Masahiko KAWAGUCHI[*1]

[*1]*Department of Anesthesiology, Nara Medical University*
[*2]*Department of Anesthesiology, Otemae Hospital*
[*3]*Institute for Clinical and Translational Science, Nara Medical University Hospital*

(Received March 4, 2025; Accepted May 3, 2025)

Objective: Laparoscopic cholecystectomy (LC) is one of the most common abdominal surgeries, requiring perioperative pain management for early recovery. Modified thoracoabdominal nerves block through perichondral approach (M-TAPA) and external oblique intercostal block (EOIB) have been reported to be effective in achieving analgesia for upper abdominal surgery. However, the efficacy of M-TAPA and EOIB in LC is still limited. We prospectively evaluated the efficacy of M-TAPA and EOIB as alternatives to the transversus abdominis plane (TAP) block.
Methods: Fifty patients were randomly assigned to one of three groups: TAP, M-TAPA, or EOIB. The primary outcome was the static pain score at 12 hours postoperatively. The secondary outcomes were postoperative pain scores, rescue narcotic use, time spent on nerve block, presence of complications, and postoperative Quality of Recovery-15 scores.
Results: Forty-one patients were included in this study. No significant difference in static Numeric Rating Scale score at 12 h postoperatively was found between the TAP and M-TAPA ($p = 0.55$) or EOIB ($p = 0.071$). The nerve block duration was shorter in the M-TAPA group ($p = 0.011$).
Conclusion: Compared with TAP block, neither M-TAPA nor EOIB showed significant differences in static pain assessment at 12 h after surgery in LC.

Key words: Laparoscopic Cholecystectomy, Nerve Block, Regional Analgesia, Postoperative Pain

INTRODUCTION

The PROSPECT (PROcedure SPECific Postoperative Pain ManagemenT) reviews provide a standard of care for perioperative pain management during laparoscopic cholecycstectomy (LC) [1, 2]. Various abdominal nerve blocks have been used for perioperative analgesia. Modified thoracoabdominal nerves block through perichondral approach (M-TAPA), which can provide widespread analgesia [3–5], and external oblique intercostal block (EOIB) are effective in upper abdominal analgesia [6]. However, little is known about the effectiveness of M-TAPA and EOIB for LC [7–10]. Therefore, we prospectively evaluated the efficacy of M-TAPA and EOIB as alternatives to transversus abdominis plane (TAP) blocks in perioperative analgesia in patients undergoing LC.

MATERIALS AND METHODS

This prospective, single-center, randomized study was conducted with the approval of the Ethics Committee of Otemae Hospital (Otemae Hospital Institutional Review Board, Approval Number: 22R111615, obtained on November 16, 2022) in Japan. This study, registered in the University Hospital Medical Information Network Clinical Trials Registry (UMIN-CTR; number UMIN000053274), was designed as a prospective randomized trial including patients undergoing LC. Informed consent was obtained from all patients for intervention and study enrollment. The CONSORT (Consolidated Standards for Reporting Studies) checklist was used for patient enrollment (Fig. 1). This study included all patients aged 20 years or older, of any sex, who were scheduled to undergo elective or urgent LC under general anesthesia between December 2022 and August 2023. The exclusion criteria were: 1) American Society of Anesthesiologists (ASA) Physical Status III or higher; 2) allergy to any of the anesthetic and analgesic medication used in this study; 3) chronic pain; 4) advanced liver and kidney failure; 5) elevated preoperative C-reactive protein (CRP) level (≥ 1.0 mg/dL); 6) history of stroke or cognitive impairment; and 7) body mass index (BMI) ≥ 35 kg/m^2 or ≤ 16 kg/m^2.

After enrollment, the patients were randomly assigned to the TAP, M-TAPA, and EOIB groups. Randomization was performed using the sealed envelope system, whereby a person other than the envelope maker removed a piece of paper with the name of each group written on it and assigned the patient to that group. Postoperative pain was assessed through inquiries made by ward nurses and self-administered

Hideki MATSUURA, Department of Anesthesiology, Nara Medical University, 840 Shijo-cho, Kashihara, Nara 634-8522, Japan
Tel: +81-744-29-8902 Fax: +81-744-23-9741 E-Mail; hmatsura0610@gmail.com, hmatsura0610@naramed-u.ac.jp

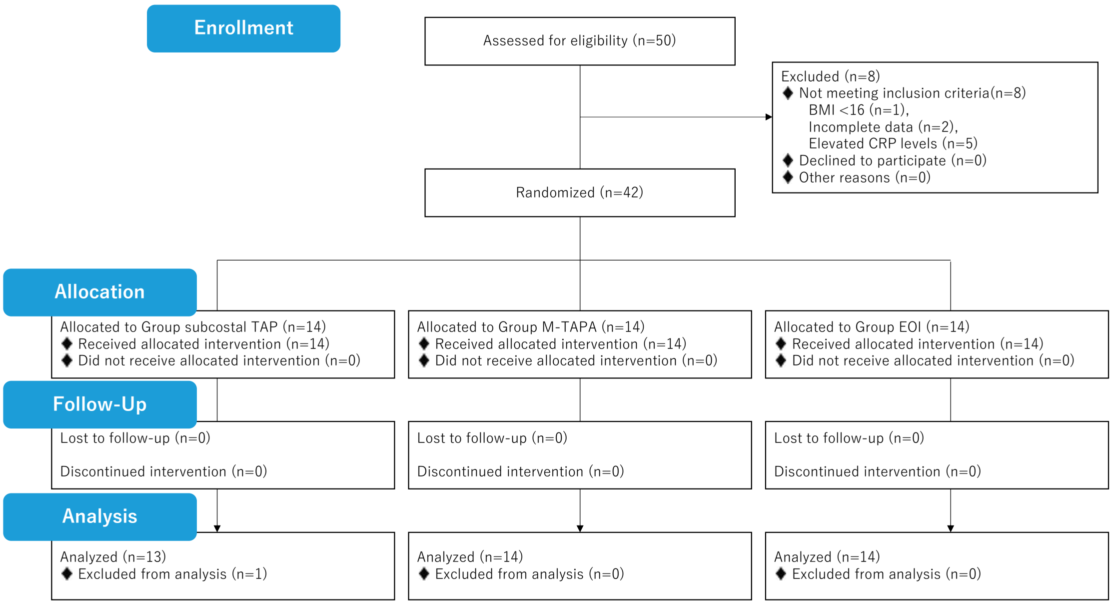

Fig. 1 CONSORT diagram of the study.
BMI; body mass index; CRP: C-reactive protein; TAP: transversus abdominis plane; M-TAPA: modified thoracoabdominal nerves block through perichondral approach; EOIB: external oblique intercostal block

patient questionnaires, ensuring that both nurses and patients were blinded to the group allocation.

All patients were admitted to the operating room without premedication. Standard monitoring, including electrocardiography, noninvasive blood pressure measurements, and peripheral oxygen saturation, was performed in all patients. Anesthesia was induced with propofol (1–2 mg/kg), remifentanil (0.2 μg/kg/min), and rocuronium (0.6–0.9 mg/kg) intravenously. After intubation, sevoflurane (0.6–0.7 minimum alveolar concentration) in a mixture of oxygen and fresh air was used for anesthesia maintenance. Before surgical incision, either nerve block was performed by anesthesiologists; intravenous fentanyl (1–2 μg/kg) was administered. The remifentanil infusion rate started at 0.1 μg/kg/min prior to skin incision and was adjusted so that the mean arterial blood pressure of the patients was within 20% of the baseline. All patients underwent the same procedure (the standard four-port technique) performed by the same surgical team. After extubation, the patients were transferred to the postoperative care unit in the surgical ward.

All patients underwent nerve block under ultrasound guidance (Epiq 7G; Philips Japan, Tokyo, Japan) with a linear probe (eL18-4, 2–22 MHz) in the supine position before skin incision. They received 25 mL of ropivacaine bilaterally (0.3%; total 50 mL), inserted with a 21-gauge 100-mm needle.

Subcostal TAP block

In the TAP group, the linear probe was applied parallel to the costal margin near the xiphoid. The needle was inserted between the rectus abdominis and transversus abdominis; local anesthetic (LA) was injected during hydrodissection between the fascia and administered across the linea semilunaris between the internal oblique muscle and transversus abdominis.

M-TAPA

In the M-TAPA group, as previously described [3], the linear probe was applied to the 9–10th costal cartilage; the needle tip was positioned below the costal cartilage. After confirming that the needle tip was between the internal oblique muscle and the transversus abdominis muscle, LA was injected.

EOIB

Following the initial report [6], a linear probe was placed in the sagittal plane between the midclavicular and anterior axillary lobes at the level of the 6th rib. LA was injected during hydrodissection of the tissue surface between the external oblique and intercostal muscles from the 6th and 7th ribs to the 8th rib, beyond the 7th rib.

In the surgical ward, postoperative pain control was performed using Patient-Controlled Analgesia (PCA) with a CADD-Solis Ambulatory infusion pump (Smiths Medical Japan, Tokyo, Japan) administering fentanyl through an intravenous infusion (0 mL/h, bolus 20 μg/mL, lockout time 10 minutes, and six times per hour). Patients with a Numeric Rating Scale (NRS) ≥ 4 were administered one bolus of the infusion pump by medical staff as a rescue analgesic. Intravenous acetaminophen (1 g) was administered every 6 h until 24 h postoperatively; non-steroidal anti-inflammatory drugs were administered if required. The pump was removed 24 h after surgery. In cases of postoperative nausea and vomiting (PONV), 1 mg granisetron hydrochloride was administered as a rescue antiemetic.

The primary endpoint was the static NRS score at 12 hours postoperatively. Secondary endpoints were the other NRS scores (at rest and during body movement) at 0, 1, 6, 12, and 24 hours postoperatively, intraoperative and postoperative narcotic use, time required for nerve blocks, presence of PONV and other complications, postoperative CRP values (max values and values at first visit after discharge), duration of hospital

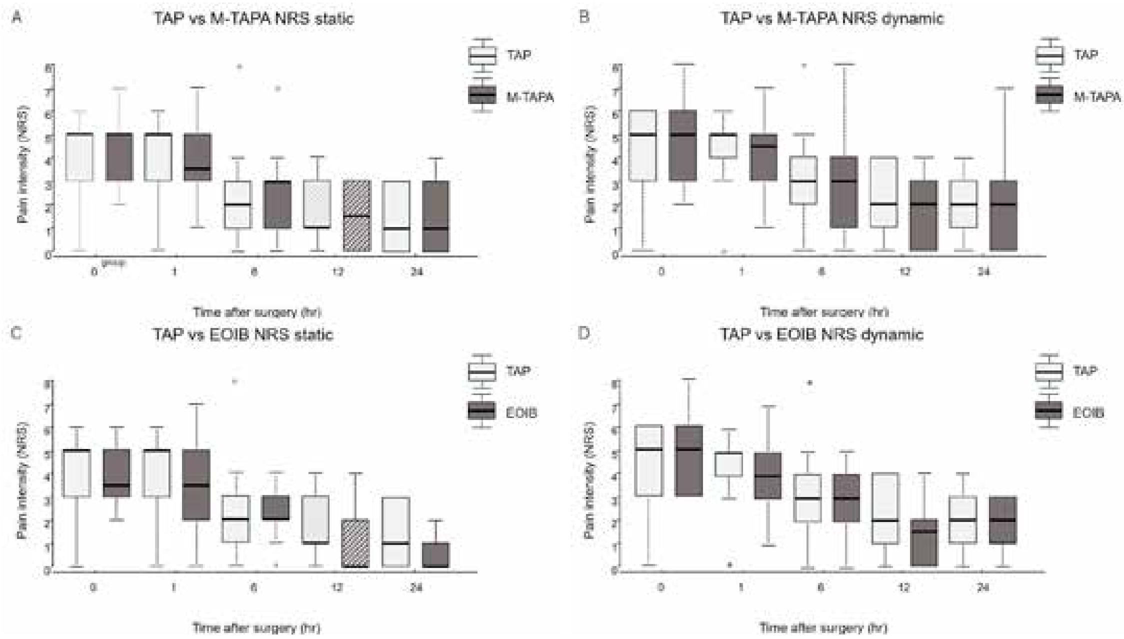

Fig. 2 Comparisons of static and dynamic NRS between TAP and M-TAPA groups (A, B), and between TAP and EOIB (C, D). Box-and-whisker plots represent the median and interquartile range of the NRS for each group. The fill for the primary outcome, which is the static NRS at 12 hours, was set to a diagonal line sloping up to the right.
NRS: numerical rating scale; TAP: transversus abdominis plane; M-TAPA: modified thoracoabdominal nerves block through perichondral approach; EOIB: external oblique intercostal block

stay, and postoperative Quality of Recovery-15 (QoR-15) scores between the TAP group and M-TAPA group or EOIB group.

Regarding the sample size calculation, we did not find any literature that specifically provided the mean and standard deviation (SD) of the NRS in previous studies that compared novel nerve blocks with TAP blocks. The SD of NRS using the TAP block in LC ranged between 1.0 and 2.0 [11–13], and the predicted SD was set within this range at 1.5. Assuming a minimum clinically important difference (MCID) of 1.65 for NRS by M-TAPA or EOIB [14], the required sample size would be 13 patients per group with an alpha probability of 0.05 and a power of 80%. Considering a 10% dropout rate, the target recruitment number of patients was 15 in each group and 45 in total.

Continuous variables are presented as the mean ± SD and the median (percentiles 25–75). Pearson's chi-square test was used to compare categorical data between the groups. Continuous outcomes were compared using the Student's t-test for normally distributed continuous variables. The Mann-Whitney U test was used for data without a normal distribution. Statistical significance was set at $P < 0.05$. To consider multiplicity, the Dunnett test was used to perform paired comparisons between the TAP and M-TAPA groups or the TAP and EOIB groups. The statistical significance threshold was set at $\alpha = 0.05$. All statistical analyses included sample size calculation were performed using a modified version of R commander, EZR (The R Foundation for Statistical Computing, Vienna, Austria, version 2.7-1) [15].

RESULTS

The Consolidated Standards of Reporting Trials (CONSORT) flow diagram was used for study enrollment (Fig. 1). During the study period, 50 patients were enrolled, and 42 judged to be eligible were randomly allocated to either group. One patient in the TAP group was excluded from the analysis because the eligibility criteria were not met after registration. Table 1 presents the demographic data and clinical characteristics of the three groups. There were no significant differences between the groups.

Table 1 Comparison of demographic data and clinical characteristics

Variables	TAP (n = 13)	M-TAPA (n = 14)	EOIB (n = 14)
Age (years)	60.5 ± 13.8	57.7 ± 16.4	62.5 ± 12.7
Gender (F/M)	5/8	5/9	6/8
Height (cm)	163.0 ± 7.5	165.4 ± 11.5	163.7 ± 10.0
Weight (kg)	65.2 ± 13.0	68.8 ± 18.2	64.6 ± 12.6
BMI (kg/m^2)	24.5 ± 4.7	24.8 ± 3.9	24.0 ± 2.8
ASA-PS I/II	5/8	5/9	4/10
Emergency (Y/N)	1/12	0/14	1/13
Pre CRP (mg/dL)	0.26 ± 0.26	0.2 ± 0.2	0.18 ± 0.19
Duration of anesthesia (min)	168.5 ± 43.2	163.8 ± 31.4	176.9 ± 57.8
Duration of surgery (min)	117.7 ± 41.9	115.4 ± 30.0	131.6 ± 56.8

Values are Mean ± SD and number. M: male; F: female; ASA-PS: American society of anesthesiologists Physical Status; BMI: body mass index; CRP: C-reactive protein; TAP: transversus abdominis plane; M-TAPA: modified thoracoabdominal nerves block through perichondral approach; EOIB: external oblique intercostal block

Table 2 The average NRS scores during postoperative first 24 h

				M-TAPA - TAP		EOIB - TAP	
hour	TAP (n = 13)	M-TAPA (n = 14)	EOIB (n = 14)	Estimate (Standard Error)	P†	Estimate (Standard Error)	P†
NRS static							
0	5 [3, 5]	5 [3, 5]	3.5 [3, 5]	0.50 (0.63)	0.65	−0.070 (0.63)	0.99
1	5 [3, 5]	3.5 [3, 4.75]	3.5 [2, 5]	−0.58 (0.68)	0.60	−0.58 (0.68)	0.60
6	2 [1, 3]	3 [1.25, 3]	2 [2, 2.75]	0.34 (0.70)	0.84	−0.088 (0.70)	0.99
12	1 [1, 3]	1.5 [0, 3]	0 [0, 1.75]	−0.49 (0.53)	0.55	−1.1 (0.53)	0.071
24	1 [0, 3]	1 [0, 2.75]	0 [0, 1]	−0.038 (0.48)	0.99	−0.97 (0.48)	0.095
NRS dynamic							
0	5 [3, 6]	5 [3, 5.75]	5 [3.25, 6]	0.77 (0.71)	0.45	0.70 (0.71)	0.51
1	5 [4, 5]	4.5 [3, 5]	4 [3, 5]	−0.30 (0.65)	0.86	−0.082 (0.65)	0.99
6	3 [2, 4]	3 [1.25, 4]	3 [2, 3.75]	−0.15 (0.74)	0.97	−0.29 (0.74)	0.89
12	2 [1, 4]	2 [0, 3]	1.5 [0, 2]	−0.45 (0.57)	0.65	−0.88 (0.57)	0.23
24	2 [1, 3]	2 [0.25, 3]	2 [1, 2.75]	−0.093 (0.61)	0.98	−0.66 (0.61)	0.45

† multiplicity adjustment using Dunnett test, Values are Median [1Q, 3Q]. NRS: numerical rating scale; TAP: transversus abdominis plane; M-TAPA: modified thoracoabdominal nerves block through perichondral approach; EOIB: external oblique intercostal block

Table 3 The secondary outcome

				M-TAPA - TAP		EOIB - TAP	
Variables	TAP (n = 13)	M-TAPA (n = 14)	EOIB (n = 14)	Estimate (Standard Error)	P†	Estimate (Standard Error)	P†
Intraoperative remifentanil (μg)	921.5 ± 446.9	892.9 ± 338.5	957.1 ± 436.3	−28.7 (157.6)	0.98	35.6 (157.6)	0.96
Intraoperative fentanyl (μg)	165.4 ± 31.5	182.1 ± 57.5	150.0 ± 27.7	16.8 (15.9)	0.47	−15.4 (15.9)	0.53
PONV	1/12	4/10	3/11	0.21 (0.38)	0.51	0.14 (0.38)	0.61
Need for antiemetics	1/12	1/13	2/12	−0.005 (0.29)	0.82	0.066 (0.29)	0.66
Need for rescue analgesia (Y/N)	10/3	11/3	11/3	0.016 (0.41)	0.15	0.016 (0.41)	0.15
Times of patient-controlled analgesia	1 [1, 3]	2 [1, 4]	1.5 [1, 2]	0.99 (0.39)	0.31	0.06 (0.39)	0.98
Max CRP (mg/dL)	3.1 ± 3.5	2.7 ± 2.3	3.6 ± 3.6	−0.46 (1.23)	0.90	0.46 (1.23)	0.90
Follow up CRP (mg/dL)	0.24 ± 0.33	0.29 ± 0.34	0.30 ± 0.47	0.047 (0.15)	0.93	0.058 (0.15)	0.90
Block time (sec)	186.5 ± 37.9	136.9 ± 56.3	187.9 ± 33.9	−49.5 (16.9)	0.011*	1.4 (16.9)	0.99
Postoperative QoR-15 score	116.9 ± 24.1	119.4 ± 20.5	121.1 ± 24.6	2.4 (8.9)	0.95	4.2 (8.9)	0.85
Duration of hospital stay (days)	4 [4, 5]	4 [3.25, 5]	4 [4, 5.75]	−0.022 (0.50)	0.99	0.55 (0.5)	0.44
Block-related complication	0	0	0		NS		NS

† multiplicity adjustment using Dunnett test, *Highly significant, Values are Mean ± SD, Median [1Q, 3Q] or number. PONV: postoperative nausea and vomiting; CRP: C-reactive protein; QoR-15: Quality of Recovery- 15; NS: non-significant; TAP: transversus abdominis plane; M-TAPA: modified thoracoabdominal nerves block through perichondral approach; EOIB: external oblique intercostal block

The primary outcomes and all pain scores are presented in Table 2 and Fig. 2. In both the M-TAPA and EOIB groups, the static NRS values were not significantly different from those in the TAP group at 12 h postoperatively or any other postoperative point, both at rest and during body movement. The secondary outcomes are presented in Table 3. There were no significant differences in the incidence of PONV, need for rescue analgesia, time to PCA, duration of hospital stay, or postoperative CRP values. The postoperative QoR-15 scores were not significantly different between the groups; there were no complications related to the block procedures in each group. The time required to perform the nerve block was significantly shorter in the M-TAPA group than in the TAP group (186.5 ± 37.9 vs. 136.9 ± 56.3; p = 0.011).

DISCUSSION

In this study, both M-TAPA and EOIB, compared with the subcostal TAP block, were generally equivalent in their effect on postoperative pain without complications. Patient satisfaction was similar in both groups.

Although LC is a minimally invasive procedure, postoperative pain, characterized by incisional and visceral pain, is reported to be most intense during the first 2–3 days; postoperative analgesic management is important [16, 17]. Local infiltration anesthesia (LIA) is most strongly recommended according to the previous and current PROSPECT guidelines [1, 2]. However, the use of ropivacaine, bupivacaine, and levobupivacaine for wound infiltration is label-off use in Japan. Thus, we chose TAP block, which was the next most highly recommended according to the PROSPECT guideline at the time of study design and was the usual practice at our institution, as the control.

Recently, new nerve blocks such as M-TAPA and EOIB have been reported to be useful for pain control in the upper abdomen [3, 6]. M-TAPA has been suggested as a useful nerve block during various abdominal surgical procedures because it provides widespread analgesia with a single injection [18]. Bilge *et al.* prospectively reported that M-TAPA reduced postoperative opioid consumption compared with the oblique subcostal TAP (OSTAP) block [19]. Our retrospective study also suggested that M-TAPA during the LC reduced postoperative analgesic use and may be an effective nerve block [7], whereas Cho *et al.* reported that M-TAPA and subcostal TAP resulted in similar levels of postoperative pain during movement [20]. This study showed no significant difference in postoperative NRS scores between the TAP and M-TAPA groups. These differences might be because the range and duration of analgesic efficacy generally overlapped between the two blocks.

EOIB was reported to provide localized analgesia in the upper abdomen, with a range of approximately Th6–10 [21]. Few studies have compared EOIB with other blocks as analgesic modalities for LC. Mehmet *et al.* compared the postoperative VAS scores of OSTAP and unilateral EOIB in patients undergoing LC [10]. There were no significant differences between the two groups at any time point up to 24 h postoperatively; patient satisfaction was similar. These results are aligned to the result of the present study. The static NRS in the EOIB group was lower at 12 h postoperatively in this study but was not statistically and clinically significant, given the MCID used to calculate the sample size. In contrast, Ohgoshi *et al.* reported that LA injection into the plane under the external oblique muscle was ineffective in the lateral branch of the thoracoabdominal nerves [22], whereas Tulgar argued the possibility of misinterpretation and injection in the wrong location [23]. Despite the controversial discussion about the anatomical basis of the inject site, there has been plenty of scope for future studies regarding the fact that the analgesic range was recognized by the pinprick test [6, 21].

As the PROSPECT review recommends LIA at the port site for LC, safety and simplicity must be considered when selecting nerve blocks. Among TAP blocks, only the subcostal TAP block or OSTAP provides effective analgesia to the upper abdomen [24]. OSTAP can provide broad-spectrum analgesia but requires multiple punctures or a longer needle for long-distance hydrodissection across the linea semilunaris, and a larger volume of LA is needed [24, 25]. The EOIB also requires hydrodissection of the external oblique intercostal plane over the rib. In contrast, M-TAPA can provide spectrum analgesia, similar to OSTAP, with only a single injection of LA. This may have been because the time required to perform the block procedure was significantly shorter in the M-TAPA group. Regarding safety, there were no complications associated with the nerve blocks in either group.

This study has some limitations. First, it was conducted at a single center and had a small sample size. Second, the NRS scores tended to be higher than those reported in other studies. This might have been influenced by the longer operative time. Although this study included emergency surgery cases of acute cholecystitis, we excluded cases of strong inflammatory response during the preoperative examination, which allowed us to exclude changes in pain assessment due to inflammation. Third, we did not identify the blocked area of the nerve blocks; in particular, whether EOIB actually blocked the lateral branches is unclear. Finally, because this study was designed based on the hypothesis that there is a significant difference between the groups, a non-significant result does not indicate that the groups are equally effective or that the effect of one technique is non-inferior to the other. Further research should consider larger sample sizes and multi-center designs to improve generalizability.

In conclusion, neither M-TAPA nor EOIB demonstrated significant differences in static pain assessment at 12 h postoperatively compared with TAP block. There was no significant difference in patient satisfaction between the two groups. Future investigations should focus on the long-term outcomes of these block techniques, such as their impact on chronic pain or patients' quality of life.

ACKNOWLEDGMENTS

We would like to thank Editage (www.editage.com) for English language editing.

We would like to acknowledge the use of Duplichecker (www.duplichecker.com) for plagiarism detection during the preparation of this manuscript.

REFERENCES

1) Barazanchi AWH, MacFater WS, Rahiri JL, Tutone S, Hill AG, Joshi GP, *et al.* Evidence-based management of pain after laparoscopic cholecystectomy: a PROSPECT review update. Br J Anaesth 2018; 121: 787–803.
2) Bourgeois C, Oyaert L, Van de Velde M, Pogatzki-Zahn E, Freys SM, Sauter AR, *et al.* Pain management after laparoscopic cholecystectomy: A systematic review and procedure-specific postoperative pain management (PROSPECT) recommendations. Eur J Anaesthesiol 2024; 41: 841–55.
3) Tulgar S, Selvi O, Thomas DT, Deveci U, Ozer Z. Modified thoracoabdominal nerves block through perichondrial approach (M-TAPA) provides effective analgesia in abdominal surgery and is a choice for opioid sparing anesthesia. J Clin Anesth 2019; 55: 109.
4) Aikawa K, Tanaka N, Morimoto Y. Modified thoracoabdominal nerves block through perichondrial approach (M-TAPA) provides a sufficient postoperative analgesia for laparoscopic sleeve gastrectomy. J Clin Anesth 2020; 59: 44–5.
5) Ohgoshi Y, Ando A, Kawamata N, Kubo EN. Continuous modified thoracoabdominal nerves block through perichondrial approach (M-TAPA) for major abdominal surgery. J Clin Anesth 2020; 60: 45–6.
6) Elsharkawy H, Kolli S, Soliman LM, Seif J, Drake RL, Mariano ER, *et al.* The External Oblique Intercostal Block: Anatomic Evaluation and Case Series. Pain Med 2021; 22: 2436–42.
7) Matsuura H, Terada Y, Rokkaku Y, Tamagawa H, Taniguchi E, Saito Y, *et al.* Analgesic efficacy of modified thoracoabdominal nerves block through the perichondrial approach in laparoscopic cholecystectomy: A retrospective study with propensity analysis. Asian J Endosc Surg 2023; 16: 648–52.
8) Gungor H, Ciftci B, Alver S, Golboyu BE, Ozdenkaya Y, Tulgar S. Modified thoracoabdominal nerve block through perichondrial approach (M-TAPA) vs local infiltration for pain management after laparoscopic cholecystectomy surgery: a randomized study. J Anesth 2023; 37: 254–60.
9) Gangadhar V, Gupta A, Saini S. Comparison of analgesic effi-

cacy of combined external oblique intercostal and rectus sheath block with local infiltration analgesia at port site in patients undergoing laparoscopic cholecystectomy: a randomized controlled trial. Anesth Pain Med (Seoul) 2024; 19: 247–55.

10) Mehmet Selim C, Halide S, Erkan Cem C, Onur K, Sedat H, Senem U. Efficacy of Unilateral External Oblique Intercostal Fascial Plane Block Versus Subcostal TAP Block in Laparoscopic Cholecystectomy: Randomized, Prospective Study. Surg Innov 2024; 31: 381–8.

11) Elamin G, Waters PS, Hamid H, O'Keeffe HM, Waldron RM, Duggan M, *et al*. Efficacy of a Laparoscopically Delivered Transversus Abdominis Plane Block Technique during Elective Laparoscopic Cholecystectomy: A Prospective, Double-Blind Randomized Trial. J Am Coll Surg 2015; 221: 335–44.

12) Ortiz J, Suliburk JW, Wu K, Bailard NS, Mason C, Minard CG, *et al*. Bilateral transversus abdominis plane block does not decrease postoperative pain after laparoscopic cholecystectomy when compared with local anesthetic infiltration of trocar insertion sites. Reg Anesth Pain Med 2012; 37: 188–92.

13) Tolchard S, Davies R, Martindale S. Efficacy of the subcostal transversus abdominis plane block in laparoscopic cholecystectomy: Comparison with conventional port-site infiltration. J Anaesthesiol Clin Pharmacol 2012; 28: 339–43.

14) Bahreini M, Safaie A, Mirfazaelian H, Jalili M. How much change in pain score does really matter to patients? Am J Emerg Med 2020; 38: 1641–6.

15) Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. Bone Marrow Transplant 2013; 48: 452–8.

16) Bisgaard T, Kehlet H, Rosenberg J. Pain and convalescence after laparoscopic cholecystectomy. Eur J Surg 2001; 167: 84–96.

17) Bisgaard T, Klarskov B, Rosenberg J, Kehlet H. Characteristics and prediction of early pain after laparoscopic cholecystectomy. Pain 2001; 90: 261–9.

18) Tanaka N, Ida M, Suzuka T, Kawaguchi M. Modified thoracoabdominal nerves block through perichondrial approach for surgical patients: a scoping review. BMC Anesthesiol. 2024; 24: 478.

19) Bilge A, Basaran B, Altiparmak B, Et T, Korkusuz M, Yarimoglu R. Comparing ultrasound-guided modified thoracoabdominal nerves block through perichondrial approach with oblique subcostal transversus abdominis plane block for patients undergoing laparoscopic cholecystectomy: a randomized, controlled trial. BMC Anesthesiol 2023; 23: 139.

20) Cho HY, Hwang IE, Lee M, Kwon W, Kim WH, Lee HJ. Comparison of modified thoracoabdominal nerve block through perichondral approach and subcostal transversus abdominis plane block for pain management in laparoscopic cholecystectomy: a randomized-controlled trial. Korean J Pain 2023; 36: 382–91.

21) Suzuka T, Tanaka N, Kadoya Y, Yamanaka T, Ida M, Nakade H, *et al*. Comparison of Analgesic Method in Laparoscopic Gastrectomy Using External Oblique Intercostal Block Versus Wound Infiltration: A Randomized Controlled Trial. J Clin Med 2024; 13: 4174.

22) Ohgoshi Y, Kawagoe I, Anetai H, Ichimura K. Injectate spread after superficial injection of thoracoabdominal nerves block through the perichondrial approach. Can J Anaesth 2023; 70: 1266–7.

23) Tulgar S. Comments on blockade of thoracoabdominal nerves through the perichondrial approach. Can J Anaesth 2024; 71: 921–2.

24) Hebbard PD, Barrington MJ, Vasey C. Ultrasound-guided continuous oblique subcostal transversus abdominis plane blockade: description of anatomy and clinical technique. Reg Anesth Pain Med 2010; 35: 436–41.

25) Tsai HC, Yoshida T, Chuang TY, Yang SF, Chang CC, Yao HY, *et al*. Transversus Abdominis Plane Block: An Updated Review of Anatomy and Techniques. Biomed Res Int 2017; 2017: 8284363.