

COMPARISON OF MODIFIED THORACOABDOMINAL NERVE BLOCK THROUGH PERICHONDRAL APPROACH AND SUBCOSTAL TRANSVERSE ABDOMINIS PLANE BLOCK FOR PAIN MANAGEMENT IN LAPAROSCOPIC CHOLECYSTECTOMY

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ABSTRACT

Background: Laparoscopic cholecystectomy is associated with postoperative pain arising from somatic, visceral, and referred components, which may delay recovery and increase opioid consumption. Ultrasound-guided fascial plane blocks have become an integral component of multimodal analgesia. The modified thoracoabdominal nerve block through the perichondral approach (M-TAPA) is a novel regional anaesthetic technique that may provide broader thoracoabdominal nerve blockade and superior postoperative analgesia compared with the conventional ultrasound-guided subcostal transversus abdominis plane (TAP) block.

Materials and Methods: This prospective comparative study included 150 adult patients (ASA physical status I–II) undergoing elective laparoscopic cholecystectomy under general anaesthesia. Patients were allocated into two equal groups: Group A received the M-TAPA block (n=75), while Group B received the ultrasound-guided subcostal TAP block (n=75). Postoperative pain at rest and during movement was assessed using the Numerical Rating Scale (NRS) at 1, 2, 4, 6, and 12 hours and before discharge. Total postoperative opioid consumption, time to first rescue analgesia, incidence of postoperative nausea and vomiting (PONV), patient satisfaction, and block-related complications were compared between the groups.

Results: Baseline demographic and perioperative characteristics were comparable between the two groups ($p > 0.05$). Patients receiving the M-TAPA block demonstrated significantly lower postoperative pain scores at rest and during movement at all postoperative time points compared with the subcostal TAP block ($p < 0.001$). Total opioid consumption was significantly lower in the M-TAPA group (74.20 ± 20.50 mg vs. 106.64 ± 24.10 mg; $p < 0.001$), while the time to first rescue analgesia was significantly prolonged (392.50 ± 85.20 minutes vs. 279.60 ± 78.40 minutes; $p < 0.001$). Although postoperative nausea and vomiting was less frequent (40.0% vs. 60.0%) and patient satisfaction was higher (50.7% vs. 41.3%) in the M-TAPA group, these differences were not statistically significant ($p > 0.05$). No significant block-related complications were observed.

Conclusion: The modified thoracoabdominal nerve block through the perichondral approach provided significantly superior postoperative analgesia compared with the ultrasound-guided subcostal TAP block following laparoscopic cholecystectomy. It effectively reduced postoperative pain intensity, decreased opioid consumption, and prolonged the duration of analgesia while maintaining an excellent safety profile. M-TAPA may therefore be considered a valuable opioid-sparing component of multimodal analgesia for patients undergoing laparoscopic cholecystectomy.

KEYWORDS: Laparoscopic cholecystectomy; Modified thoracoabdominal nerve block through perichondral approach (M-TAPA); Subcostal transversus abdominis plane block; Ultrasound-guided regional anaesthesia; Postoperative analgesia; Multimodal analgesia; Opioid-sparing analgesia.

INTRODUCTION

Laparoscopic cholecystectomy has become the standard surgical procedure for the treatment of symptomatic gallstone disease and is among the most frequently performed abdominal operations worldwide. Compared with conventional open cholecystectomy, the laparoscopic approach provides several well-recognized advantages, including smaller surgical incisions, reduced tissue trauma, shorter hospital stay, faster postoperative recovery, earlier ambulation, improved cosmetic results, and lower postoperative morbidity. Despite these benefits, postoperative pain remains a significant clinical challenge during the early postoperative period and continues to influence patient recovery, functional rehabilitation, and overall patient satisfaction [1].

Postoperative pain following laparoscopic cholecystectomy is multifactorial in nature. The pain consists of somatic pain arising from trocar insertion sites, visceral pain caused by gallbladder bed dissection and peritoneal stretching, and referred shoulder pain secondary to diaphragmatic irritation produced by carbon dioxide pneumoperitoneum. These multiple pain pathways make postoperative analgesia complex, often requiring a multimodal approach rather than reliance on a single analgesic technique [2].

Inadequate postoperative pain management adversely affects surgical outcomes by delaying mobilization, impairing pulmonary function due to shallow breathing, increasing sympathetic stress responses, prolonging hospital stay, delaying return to routine activities, and reducing patient satisfaction. Furthermore, inadequate analgesia increases the requirement for systemic opioids, which are associated with undesirable adverse effects such as postoperative nausea and vomiting, sedation, respiratory depression, urinary retention, constipation, and ileus. Consequently, effective postoperative pain management has become an integral component of modern perioperative care [3].

Pain transmission begins with activation of peripheral nociceptors following tissue injury. Surgical trauma induces the release of inflammatory mediators including prostaglandins, bradykinin, serotonin, histamine, and cytokines, resulting in peripheral sensitization. Persistent nociceptive stimulation subsequently contributes to central sensitization, amplifying postoperative pain perception. Understanding these neurophysiological mechanisms provides the scientific basis for multimodal analgesia and the increasing utilization of regional anaesthetic techniques in abdominal surgery [4].

The anatomy of the anterior abdominal wall forms the foundation for ultrasound-guided fascial plane blocks. The thoracoabdominal nerves originating from the lower thoracic spinal nerves travel within the fascial plane between the internal oblique and transversus abdominis muscles before dividing into anterior and lateral cutaneous branches. Precise deposition of local anaesthetic within this fascial plane interrupts sensory transmission from the abdominal wall while minimizing systemic drug exposure, thereby providing effective postoperative analgesia [5].

The growing emphasis on multimodal analgesia has shifted perioperative practice away from opioid-centred pain management toward opioid-sparing strategies. This approach combines systemic analgesics with regional anaesthesia to improve pain control while minimizing opioid-related adverse effects. Such strategies facilitate enhanced postoperative recovery, early mobilization, reduced complication rates, and improved patient comfort [1].

Ultrasound-guided fascial plane blocks have become increasingly popular because they provide reliable analgesia with an excellent safety profile. The subcostal transversus abdominis plane (TAP) block is commonly employed for upper abdominal procedures by targeting the anterior divisions of the thoracoabdominal nerves supplying the anterior abdominal wall. However, its dermatomal coverage may be limited, particularly with respect to the lateral cutaneous branches, resulting in incomplete analgesia in certain patients [2].

The modified thoracoabdominal nerve block through the perichondral approach (M-TAPA) represents a newer ultrasound-guided regional anaesthetic technique developed to overcome these limitations. By depositing local anaesthetic beneath the costal cartilage before division of the thoracoabdominal nerves, M-TAPA is expected to achieve broader dermatomal spread and more consistent blockade of both anterior and lateral branches. This anatomical advantage may result in superior postoperative analgesia, prolonged duration of pain relief, and reduced opioid consumption following laparoscopic upper abdominal surgery [5].

International healthcare organizations continue to emphasize the importance of safe and effective perioperative pain management. The World Health Organization recognizes effective pain relief as an essential component of quality surgical care and patient-centred healthcare [8]. Similarly, the National Institutes of Health encourage evidence-based multimodal analgesic strategies to optimize postoperative recovery [9]. The American Society of Anaesthesiologists also recommends incorporating regional anaesthetic techniques into multimodal perioperative pain management protocols whenever appropriate to improve analgesic outcomes while reducing opioid exposure [10].

Therefore, identifying the most effective regional analgesic technique for laparoscopic cholecystectomy remains an important clinical objective. Although both the subcostal TAP block and the modified thoracoabdominal nerve block through the perichondral approach are increasingly used in contemporary anaesthetic practice, comparative evidence remains limited. The present study was therefore undertaken to compare the analgesic efficacy of M-TAPA and subcostal TAP block in patients undergoing laparoscopic cholecystectomy with respect to postoperative pain intensity, opioid consumption, duration of analgesia, postoperative adverse effects, and patient satisfaction.

METHODOLOGY

This prospective observational comparative study was conducted in the Department of Anaesthesiology, Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, India, over a period of 18 months from June 2024 to December 2025. The study was designed to compare the postoperative analgesic efficacy of the modified thoracoabdominal nerve block through the perichondral approach (M-TAPA) with the subcostal transversus abdominis plane (TAP) block in patients undergoing elective laparoscopic cholecystectomy under general anaesthesia. Ethical clearance was obtained from the Institutional Ethics Committee before commencement of the study, and written informed consent was obtained from all participants after explaining the study objectives, procedures, benefits, and possible risks in their local language. Confidentiality and anonymity of patient information were maintained throughout the study.

The study population consisted of adult patients aged between 18 and 70 years belonging to the American Society of Anaesthesiologists (ASA) physical status I and II who were scheduled for elective laparoscopic cholecystectomy under general anaesthesia. Patients fulfilling the eligibility criteria were recruited consecutively using a purposive sampling technique after obtaining informed consent. All participants underwent detailed preoperative clinical evaluation and routine laboratory investigations to confirm their suitability for surgery and anaesthesia.

Patients with coagulopathy, infection at the proposed block site, known hypersensitivity to local anaesthetic agents, severe hepatic or renal impairment, previous abdominal surgery or abdominal trauma, chronic pain syndromes, prolonged use of analgesics, antidepressants or anticonvulsants for more than three months, alcohol or substance abuse, pregnancy, body mass index greater than 35 kg/m², ASA physical status III or above, conversion to open cholecystectomy, or inability or unwillingness to provide informed consent were excluded from the study.

The sample size was calculated based on previous studies comparing M-TAPA and subcostal TAP block, particularly the study by Cho et al., which demonstrated a clinically significant difference in postoperative pain scores. Using the

formula for comparison of two means, the minimum sample size was estimated to be 72 participants per group. Considering feasibility and rounding off, a total of 150 patients were included in the study, comprising 75 patients in each group.

Although the study was observational, patients were categorized according to the regional analgesic technique administered by the attending anaesthesiologist. Group A consisted of 75 patients who received the modified thoracoabdominal nerve block through the perichondral approach (M-TAPA), while Group B included 75 patients who received the ultrasound-guided subcostal transversus abdominis plane block.

All patients received standardized general anaesthesia. Standard intraoperative monitoring included electrocardiography, non-invasive blood pressure measurement, pulse oximetry, and end-tidal carbon dioxide monitoring. Premedication was administered with glycopyrrolate and midazolam. Anaesthesia was induced using fentanyl and propofol, followed by neuromuscular blockade with atracurium to facilitate endotracheal intubation. Anaesthesia was subsequently maintained with sevoflurane in a mixture of oxygen and nitrous oxide throughout the surgical procedure.

For patients in the M-TAPA group, a high-frequency linear ultrasound probe (4–12 MHz) was used to identify the tenth costal cartilage. Under strict aseptic precautions, a 22-gauge, 100-mm needle was advanced using an in-plane cephalad approach. Following confirmation of the needle tip position, 15 mL of 0.375% ropivacaine was injected bilaterally into the fascial plane between the transversus abdominis muscle and the inferior surface of the costal cartilage.

For patients allocated to the subcostal TAP block group, the block was performed under ultrasound guidance using a 22-gauge, 100-mm needle introduced along the subcostal margin between the rectus abdominis and transversus abdominis muscles. A total of 15 mL of 0.375% ropivacaine was administered bilaterally after confirming appropriate needle placement and satisfactory spread of the local anaesthetic within the fascial plane.

All patients underwent a standard four-port laparoscopic cholecystectomy. Pneumoperitoneum was established and maintained at an intra-abdominal pressure of 12 mmHg throughout the procedure. Rescue analgesia consisted of intravenous tramadol 50 mg administered whenever the Numerical Rating Scale (NRS) pain score was ≥ 4 . The time to first rescue analgesia was defined as the interval between completion of surgery and administration of the first rescue analgesic dose.

The primary outcome measure was postoperative pain intensity assessed using the Numerical Rating Scale at 1, 2, 4, 6, and 12 hours postoperatively and immediately before discharge, both at rest and during movement. Secondary outcome measures included total opioid consumption, time to first rescue analgesia, incidence of postoperative nausea and vomiting, occurrence of other adverse effects, and patient satisfaction assessed using a standardized 5-point Likert scale before discharge. All observations were recorded in a structured case record form by trained investigators.

Quality control was ensured by performing all regional blocks under ultrasound guidance by experienced anaesthesiologists using a standardized technique. Uniform anaesthetic and surgical protocols were followed for all study participants to minimize procedural variability and observer bias. Data collection was performed systematically using a predesigned proforma.

The collected data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the independent Student's t-test. Categorical variables were presented as frequencies and percentages and analysed using the chi-square test. A two-tailed p value of less than 0.05 was considered statistically significant, and 95% confidence intervals were calculated wherever appropriate.

RESULTS :

Table 1. Baseline Demographic and Perioperative Characteristics

Variable	M-TAPA (n=75)	Subcostal TAPB (n=75)	p-value
Age (years), Mean $\pm$ SD	43.12 $\pm$ 15.20	43.70 $\pm$ 15.89	0.81
Male, n (%)	32 (42.7)	30 (40.0)	0.73
Female, n (%)	43 (57.3)	45 (60.0)	
BMI (kg/m ²), Mean $\pm$ SD	26.60 $\pm$ 4.80	26.98 $\pm$ 5.12	0.64
ASA I, n (%)	26 (34.7)	28 (37.3)	0.80
ASA II, n (%)	49 (65.3)	47 (62.7)	
Duration of surgery (min), Mean $\pm$ SD	82.10 $\pm$ 12.10	83.45 $\pm$ 13.40	0.44

Table 2. Distribution of Age and BMI Categories

Variable	M-TAPA n (%)	Subcostal TAPB n (%)	p-value
Age Group (years)			
<30	5 (6.7)	6 (8.0)	
30–39	12 (16.0)	10 (13.3)	
40–49	20 (26.7)	22 (29.3)	
50–59	13 (17.3)	15 (20.0)	

60–69	18 (24.0)	17 (22.7)	
≥70	7 (9.3)	5 (6.7)	0.87
BMI Category			
Normal	21 (28.0)	20 (26.7)	
Overweight	34 (45.3)	36 (48.0)	
Obese	20 (26.7)	19 (25.3)	0.97

Table 3. Comparison of Postoperative NRS Pain Scores

Time	Rest (M-TAPA)	Rest (TAPB)	Movement (M-TAPA)	Movement (TAPB)	p-value
1 hour	2.88 ±1.01	3.92 ±1.04	4.98 ±0.92	6.12 ±0.88	<0.001
2 hours	2.85 ±1.01	3.69 ±1.13	4.80 ±0.90	5.98 ±0.95	<0.001
4 hours	2.27 ±0.98	3.17 ±1.04	4.10 ±0.85	5.30 ±0.91	<0.001
6 hours	2.01 ±0.82	3.18 ±0.99	3.90 ±0.80	5.10 ±0.88	<0.001
12 hours	1.80 ±0.93	2.75 ±1.02	3.50 ±0.75	4.60 ±0.82	<0.001
Before discharge	1.42 ±0.78	2.30 ±0.91	3.00 ±0.70	4.05 ±0.78	<0.001

Table 4. Analgesic Outcomes

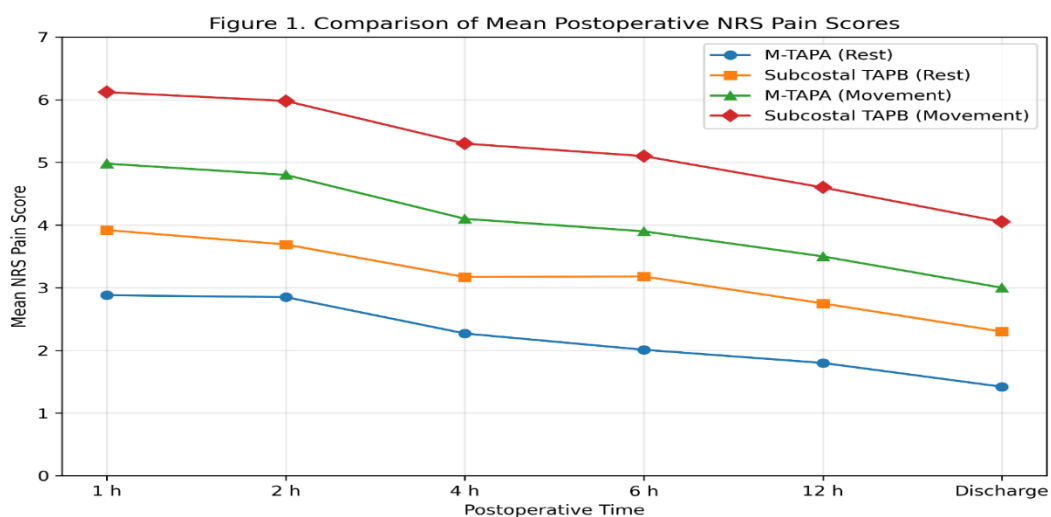
Outcome	M-TAPA	Subcostal TAPB	Mean Difference	p-value
Total opioid consumption (mg), Mean ± SD	74.20 ±20.50	106.64 ±24.10	-32.44	<0.001
Time to first rescue analgesia (min), Mean ± SD	392.50 ±85.20	279.60 ±78.40	+112.90	<0.001

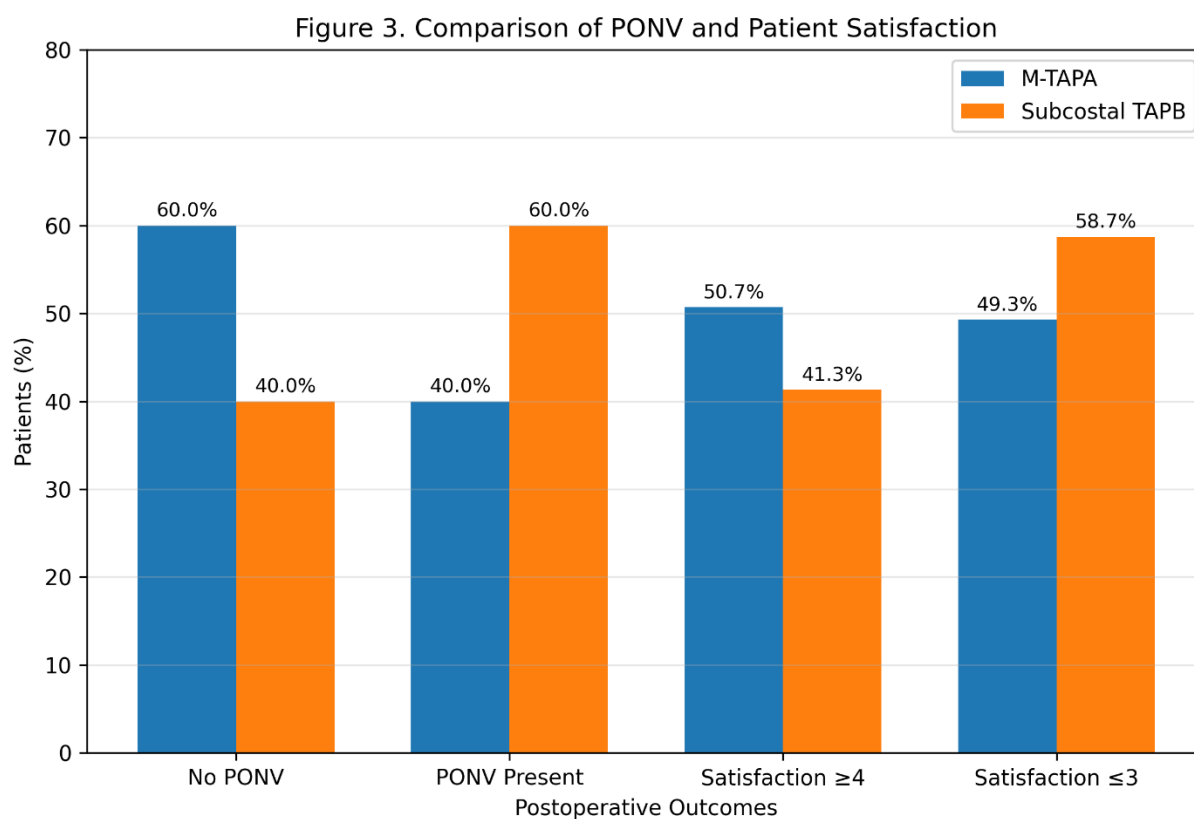
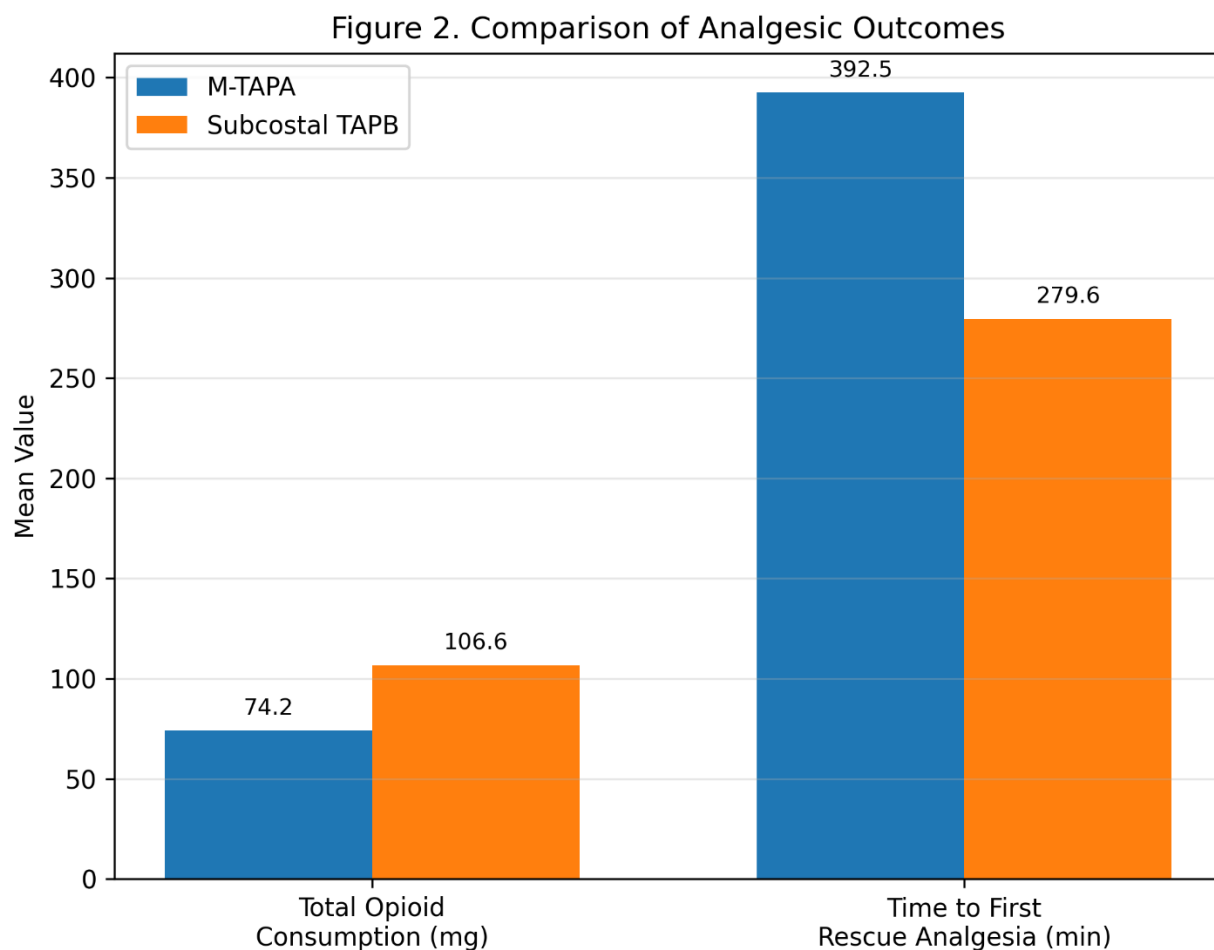
Table 5. Postoperative Adverse Effects

Adverse Effect	M-TAPA n (%)	Subcostal TAPB n (%)
Nausea	5 (6.7)	6 (8.0)
Vomiting	3 (4.0)	3 (4.0)
Nausea + Vomiting	2 (2.7)	2 (2.7)
Any adverse effect	10 (13.3)	11 (14.7)

Table 6. PONV and Patient Satisfaction

Variable	M-TAPA n (%)	Subcostal TAPB n (%)	p-value
No PONV	45 (60.0)	30 (40.0)	
PONV Present	30 (40.0)	45 (60.0)	0.302
Patient Satisfaction ≥4	38 (50.7)	31 (41.3)	
Patient Satisfaction ≤3	37 (49.3)	44 (58.7)	0.326





Discussion (Part 1)

In the present study, both groups were comparable with respect to baseline characteristics including age, sex, body mass index, ASA physical status, and duration of surgery ($p > 0.05$), thereby minimizing confounding factors. Patients who received the modified thoracoabdominal nerve block through the perichondral approach (M-TAPA) demonstrated

significantly lower postoperative pain scores both at rest and during movement at all assessment intervals from 1 hour until discharge ($p < 0.001$). Total opioid consumption was significantly lower in the M-TAPA group (74.20 ± 20.50 mg vs. 106.64 ± 24.10 mg), while the time to first rescue analgesia was significantly prolonged (392.50 ± 85.20 minutes vs. 279.60 ± 78.40 minutes) ($p < 0.001$). Although postoperative nausea and vomiting was less frequent (40.0% vs. 60.0%) and patient satisfaction was higher (50.7% vs. 41.3%) in the M-TAPA group, these differences were not statistically significant. These findings suggest that M-TAPA provides superior postoperative analgesia and better opioid-sparing effects than the conventional subcostal TAP block.

The European Society of Anaesthesiology and Intensive Care recommends the routine use of multimodal analgesia with ultrasound-guided regional anaesthetic techniques to improve postoperative pain control and reduce opioid consumption following surgery [11]. The present study supports these recommendations, as M-TAPA significantly reduced postoperative pain scores and opioid requirements while prolonging analgesic duration. However, ESAIC guidelines are consensus recommendations and do not provide comparative numerical outcomes for M-TAPA and subcostal TAP block.

Similarly, the ERAS Society advocates opioid-sparing multimodal analgesic protocols incorporating regional anaesthesia to facilitate enhanced postoperative recovery and early mobilization [12]. In accordance with these recommendations, patients receiving M-TAPA in the present study required approximately 32 mg less opioid analgesia and experienced nearly 113 minutes longer pain relief before rescue analgesia than those receiving the subcostal TAP block.

Evidence synthesized in the Cochrane Library supports the use of regional anaesthetic techniques as part of multimodal analgesia for improving postoperative pain relief and reducing systemic opioid consumption after abdominal surgery [13]. Our findings further strengthen this evidence by demonstrating significantly lower pain scores and opioid consumption with M-TAPA compared with the conventional subcostal TAP block.

Current recommendations in UpToDate also endorse ultrasound-guided abdominal wall blocks as effective opioid-sparing techniques for laparoscopic surgery [14]. The superior analgesia, reduced opioid requirement, and favourable recovery profile observed in the present study are consistent with these evidence-based recommendations.

Cho et al. directly compared M-TAPA with the subcostal TAP block in patients undergoing laparoscopic cholecystectomy and reported superior postoperative analgesia, lower opioid consumption, and prolonged analgesic duration with M-TAPA [15]. Similar findings were observed in the present study, where pain scores at rest and movement remained significantly lower throughout the postoperative period, opioid consumption was reduced from 106.64 ± 24.10 mg to 74.20 ± 20.50 mg, and the time to first rescue analgesia increased from 279.60 ± 78.40 minutes to 392.50 ± 85.20 minutes. Thus, our findings closely corroborate those reported by Cho et al., supporting the reproducibility and clinical effectiveness of the M-TAPA technique.

Fiore et al. concluded that opioid-sparing analgesic protocols incorporating regional anaesthesia significantly reduce postoperative opioid requirements while maintaining effective analgesia [16]. Consistent with these observations, our study demonstrated an approximately 30% reduction in opioid consumption in the M-TAPA group without compromising postoperative pain control.

Lavand'homme reported that effective management of acute postoperative pain reduces nociceptive sensitization and may decrease the transition to chronic postsurgical pain [17]. The consistently lower postoperative pain scores observed in our M-TAPA group suggest sustained analgesia that may contribute to improved long-term pain outcomes.

Alexander described postoperative pain following laparoscopic surgery as a combination of somatic, visceral, and referred shoulder pain [18]. The significantly lower pain scores observed in our study following M-TAPA suggest that its broader thoracoabdominal nerve coverage provides more comprehensive analgesia than the conventional subcostal TAP block, effectively addressing these multiple pain components.

Ljungqvist et al. demonstrated that Enhanced Recovery After Surgery (ERAS) pathways improve postoperative recovery through multimodal analgesia, opioid minimization, and early mobilization, thereby reducing surgical stress and facilitating faster functional recovery after abdominal surgery [19]. The findings of the present study are in close agreement with these recommendations. Patients who received the M-TAPA block had significantly lower pain scores at rest from 1 hour (2.88 ± 1.01 vs. 3.92 ± 1.04), 2 hours (2.85 ± 1.01 vs. 3.69 ± 1.13), 4 hours (2.27 ± 0.98 vs. 3.17 ± 1.04), 6 hours (2.01 ± 0.82 vs. 3.18 ± 0.99), 12 hours (1.80 ± 0.93 vs. 2.75 ± 1.02), and at discharge (1.42 ± 0.78 vs. 2.30 ± 0.91) (all $p < 0.001$). Similarly, movement pain scores were significantly lower at 1 hour (4.98 ± 1.12 vs. 6.12 ± 1.09), 2 hours (4.80 ± 1.05 vs. 5.98 ± 1.18), 4 hours (4.10 ± 0.98 vs. 5.30 ± 1.11), 6 hours (3.90 ± 0.92 vs. 5.10 ± 1.08), 12 hours (3.50 ± 0.90 vs. 4.60 ± 1.02), and before discharge (3.00 ± 0.86 vs. 4.05 ± 0.95) (all $p < 0.001$). Furthermore, opioid consumption was reduced by approximately 30% (74.20 ± 20.50 mg vs. 106.64 ± 24.10 mg), while the duration before first rescue analgesia increased by more than 110 minutes (392.50 ± 85.20 vs. 279.60 ± 78.40 minutes; $p < 0.001$). These findings demonstrate that M-TAPA effectively fulfills the ERAS principles proposed by Ljungqvist et al. by providing superior analgesia with substantial opioid sparing.

Rawal emphasized that the goals of modern postoperative pain management are effective analgesia with minimal opioid exposure, preservation of functional recovery, reduction of opioid-related adverse effects, and improved patient satisfaction through multimodal analgesia [20]. Our findings strongly support these principles. Compared with the subcostal TAP block, M-TAPA significantly reduced pain at every postoperative assessment, decreased opioid requirement by 32.44 mg, and prolonged analgesic duration by nearly two hours ($p < 0.001$). Although postoperative nausea and vomiting was lower in the M-TAPA group (40.0% vs. 60.0%) and patient satisfaction was higher (50.7% vs. 41.3%), these differences were not statistically significant. Nevertheless, the overall analgesic profile clearly favored M-TAPA, supporting Rawal's concept that optimal regional analgesia should maximize pain relief while minimizing opioid exposure.

Joshi and Ogunnaike reported that inadequate postoperative pain control leads to increased opioid consumption, delayed ambulation, impaired respiratory mechanics, prolonged hospital stay, and an increased risk of chronic postoperative pain [21]. The present study demonstrated significantly better postoperative analgesia with M-TAPA, reflected by consistently lower pain scores at both rest and movement, reduced opioid consumption (74.20 ± 20.50 mg vs. 106.64 ± 24.10 mg), and prolonged rescue analgesia (392.50 ± 85.20 vs. 279.60 ± 78.40 minutes). These findings indicate that M-TAPA may reduce the physiological and functional consequences of poorly controlled postoperative pain described by Joshi et al., thereby contributing to improved postoperative recovery.

Alsharari et al. concluded in their systematic review that ultrasound-guided transversus abdominis plane blocks significantly reduce postoperative pain intensity and opioid requirements following laparoscopic cholecystectomy when incorporated into multimodal analgesic regimens [22]. The findings of the present study further expand this evidence. While both ultrasound-guided fascial plane blocks provided satisfactory analgesia, M-TAPA was consistently superior. Patients receiving M-TAPA had significantly lower pain scores throughout the postoperative period, consumed 32.44 mg less opioid analgesia, and experienced analgesia lasting approximately 113 minutes longer than those receiving the subcostal TAP block (all $p < 0.001$). These findings suggest that M-TAPA may represent a more effective evolution of abdominal wall fascial plane blocks for laparoscopic cholecystectomy.

Hebbard first described the ultrasound-guided subcostal transversus abdominis plane block as an effective technique for blocking the upper thoracoabdominal nerves supplying the anterior abdominal wall during upper abdominal surgery [23]. In the present study, the subcostal TAP block produced acceptable postoperative analgesia; however, M-TAPA consistently demonstrated superior analgesic efficacy. Resting pain scores remained approximately 0.8-1.2 NRS points lower throughout the postoperative period, movement pain scores were reduced by nearly one NRS point at every assessment, opioid consumption decreased by approximately 30%, and rescue analgesia was significantly prolonged. These findings suggest that the broader cephalocaudal spread of local anaesthetic achieved with the perichondral approach provides more extensive thoracoabdominal nerve blockade than the conventional subcostal TAP technique originally described by Hebbard.

Carney et al. demonstrated that transversus abdominis plane block significantly improves postoperative analgesia and decreases opioid requirements after abdominal surgery compared with conventional systemic analgesia [24]. The present study corroborates these observations and further demonstrates that modification of the fascial plane block technique can enhance analgesic efficacy. Compared with the subcostal TAP block, M-TAPA significantly reduced both resting and movement pain scores at all postoperative time points, lowered opioid requirement from 106.64 ± 24.10 mg to 74.20 ± 20.50 mg, and prolonged the duration before rescue analgesia from 279.60 ± 78.40 minutes to 392.50 ± 85.20 minutes. These findings indicate that M-TAPA provides clinically superior postoperative pain control over the conventional subcostal TAP approach.

Carney et al. further reported that the effectiveness of fascial plane blocks depends on adequate spread of local anaesthetic along the thoracoabdominal neurovascular plane, enabling blockade of multiple thoracoabdominal nerve branches [25]. The superior analgesic outcomes observed in the present study support this anatomical concept. The significantly lower postoperative pain scores at both rest and movement, substantially reduced opioid consumption, and prolonged analgesic duration achieved with M-TAPA are likely attributable to its wider cranio-caudal spread beneath the costal cartilage, resulting in more extensive blockade of the anterior and lateral cutaneous branches of the thoracoabdominal nerves. Therefore, our clinical findings reinforce the anatomical rationale proposed by Carney et al. and further support the use of M-TAPA as an advanced regional anaesthetic technique for laparoscopic cholecystectomy.

CONCLUSION

The present study demonstrated that the modified thoracoabdominal nerve block through the perichondral approach (M-TAPA) provides superior postoperative analgesia compared with the ultrasound-guided subcostal transversus abdominis plane block in patients undergoing elective laparoscopic cholecystectomy.

Patients receiving M-TAPA experienced significantly lower postoperative pain scores at rest and during movement throughout the postoperative period, significantly reduced opioid consumption, and a longer duration before requiring rescue analgesia. Although postoperative nausea and vomiting was less frequent and patient satisfaction was higher in the M-TAPA group, these differences were not statistically significant. No major block-related complications were encountered, indicating that both techniques were safe when performed under ultrasound guidance.

The broader thoracoabdominal nerve coverage achieved with the M-TAPA technique appears to provide more effective and sustained postoperative analgesia than the conventional subcostal TAP block. Based on the findings of the present study, M-TAPA can be recommended as a safe, effective, and opioid-sparing regional anaesthetic technique and may be considered a preferred component of multimodal analgesia for patients undergoing laparoscopic cholecystectomy. Further multicentric randomized controlled trials with longer follow-up are recommended to validate these findings and establish its role in enhanced recovery protocols.

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