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Original Research Article

Comparative Analgesic Efficacy of Ultrasound-Guided Single-Shot and Continuous TAP Block Versus IV-PCA in Laparoscopic Cholecystectomy

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Abstract:

Background: Despite minimal invasiveness, laparoscopic cholecystectomy causes significant postoperative pain. Opioid-based IV-PCA is effective but associated with adverse effects. Ultrasound-guided transversus abdominis plane (TAP) block offers an opioid-sparing alternative; however, the benefit of continuous infusion over single-shot block remains unclear.

Aim: To compare analgesic efficacy of ultrasound-guided single-shot TAP block, continuous TAP block, and IV-PCA following laparoscopic cholecystectomy.

Methodology: In this prospective randomized controlled study, 90 ASA I–II patients were allocated into three groups (n=30 each): Group A–IV-PCA, Group B–single-shot TAP + IV-PCA, and Group C–continuous TAP block. Pain scores (NRS) were assessed up to 48 hours. Opioid consumption, rescue analgesia, complications, and patient satisfaction were recorded.

Result: Demographics were comparable. Pain scores at rest and movement were highest in Group A, intermediate in Group B, and lowest in Group C at all intervals ($p<0.001$). Mean oxycodone consumption decreased from 28.4±6.2 mg (A) to 18.7±5.1 mg (B) and 10.9±4.3 mg (C). Rescue analgesia requirement was 70%, 33.3%, and 13.3% respectively. Nausea and vomiting were significantly lower in Group C. Patient satisfaction was highest with continuous TAP block (excellent 66.7%).

Conclusion: Continuous TAP block provides superior and prolonged analgesia with reduced opioid use and complications compared with single-shot TAP block and IV-PCA, making it the most effective modality after laparoscopic cholecystectomy.

Keywords: TAP block, continuous infusion, IV-PCA, laparoscopic cholecystectomy, postoperative pain, multimodal analgesia.

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Introduction

The management of pain after surgery is an essential part of perioperative care since it directly affects the recovery of the patient, satisfaction, early discharge, and the final surgical results. The great objective of pain management in the postoperative period is to ensure that the dosage of the drugs is reduced in order to ensure that any side effects are minimized without compromising analgesia [1]. Poor pain management after surgery has not only been associated with patients experiencing pain but also long hospitalization, poor ambulation, poor pulmonary functioning and high chances of thromboembolic complications. Therefore, multimodal and opioid-sparing analgesics are playing an increasingly prominent role in the practice of perioperative analgesia.

Laparoscopic cholecystectomy is now the gold-standard approach to the treatment of symptomatic cases of gallstone disease due to its minimally invasive characteristics, reduced incision rates, expedited recovery and reduced hospitalization rates than open surgery. Nonetheless, laparoscopic cholecystectomy, though regarded as minimally invasive, often leads to moderate-to-severe postoperative pain [2]. The postoperative pain in relation to the given procedure is multifactorial and consists of somatic pain related to the areas of trocar insertion, the visceral pain related to the dissection of the gallbladder, and the referred shoulder pains due to the irritation of the diaphragm by pneumoperitoneum. The worst period of pain is typically the first 24 hours of postoperative period that can disrupt respiratory

mechanics which can predispose the patient to atelectasis and postoperative pulmonary complications.

Historically, the most commonly used approach to acute postoperative pain management was intravenous patient-controlled analgesia (IV-PCA) based on opioids, and these approaches are frequently combined with non-steroidal anti-inflammatory drugs (NSAIDs). IV-PCA offers self-determination in patients and gives an option of increasing or decreasing analgesic dose based on personal needs. However, there are a number of side effects linked to the administration of opioids including postoperative nausea and vomiting (PONV), dizziness, pruritus, urinary retention, sedation and respiratory depression [3]. The complications can slow down the discharge, decrease the patient satisfaction, as well as raise the cost of healthcare. Side effects of opioids are especially unwanted in ambulatory and short stay surgery, such as laparoscopic cholecystectomy, since quick recovery time is anticipated [4].

Over the previous few years, the use of regional anesthesia methods in multimodal analgesia protocols has become more popular to minimize opioid use and enhance recovery outcomes. The ultrasound-guided transversus abdominis plane (TAP) block is one of these methods that have proved to be useful as an alternative method of postoperative analgesia after abdominal operations. The TAP block is an injection of local anesthetic between the internal oblique and transversus abdominis, in the fascial plane, thus blocking the sensory nerves of the anterior abdominal wall [5].

In the place of the opioid-based IV-PCA, ultrasound-guided transversus abdominis plane block has been extensively employed in the management of pain following the abdominal surgery. Single-shot technique has been utilized in most of the studies that involve TAP block [6,7]. Single injection of a local anesthetic into the transversus abdominis fascial plane containing the nerves of ventral ramus T6-L1 in the areas of surgical incisions can provide pain relief and may reduce the pain scores to 24 h postoperative [8]. Owing to the fact that laparoscopic cholecystectomy mostly implies pain parietal to the anterior abdominal wall in the area of the trocars, the blockage of these nerves leads to important analgesic effect.

Ultrasound guidance has also increased the safety and accuracy of the TAP block through the ability to visualize the anatomical structures, advancing the needle and the distribution of local anesthetic in real-time. Ultrasound-guided TAP block has less complications than landmark-based methods, including intraperitoneal injections and better block success rate. It has therefore emerged as a desirable local analgesic method in enhanced recovery guidelines as far as laparoscopic surgeries of the abdomen are concerned.

Nonetheless, the analgesic effect of one-shot TAP block is short. Sensory blockade duration following a single injection of TAP block is an average of 6-12 hours and a mean analgesic duration is 9.5(interquartile range [IQR] 8.5 to 11.9) hours [9] and therefore early analgesic treatment is required during the postoperative period. Since the majority of laparoscopic cholecystectomy patients continue to have postoperative pain beyond this time, supplemental systemic analgesics may still be required by the patients after the block expires. Such a restriction decreases the efficacy of the technique as a modality of analgesia.

Continuous regional analgesia with the use of catheter-based infusion methods have been considered to overcome this short duration of action of a single-shot block. The sustained administration of local anesthesia in the fascial plane by the use of continuous infusion prolongs analgesia and ensures stable analgesia. There is very little literature available concerning the utility of continuously infused local anesthetics by indwelling catheters in the TAP [10,11]. Although the evidence is minimal, TAP block in continuous mode has a range of theoretical benefits such as extended analgesia, opioid reduction, higher level of patient comfort, and enhanced functional recovery.

Long-term opioid-sparing analgesia is desirable in the setting of laparoscopic cholecystectomy, in which early ambulation and rapid discharge are the key objectives. Contingent TAP block can be better and more effective in the appearance of analgesia than single-shot TAP block and prevents the negative effects of opioids in relation to IV-PCA. Moreover, the continuation of constant analgesia can decrease pain variability, enhance the quality of sleep, and help to achieve early oral food and movement.

Research IV-PCA is still commonly applied as it is familiar and is easy to administer, however, with increased focus on promoting positive surgery recovery (ERAS) regimes, it is important to emphasize the value of regional anesthesia. The question of whether continuous TAP block has clinically significant benefits compared to single-shot TAP block and systemic opioid-based analgesia should be answered to optimize pain management approaches to postoperative pain management. A comparative study of these methods can assist in determining which method can be regarded as the most effective and safe in the case of patients undergoing laparoscopic cholecystectomy.

Thus, the purpose of this study was to compare the analgesic properties of ultrasound-guided single-shot and continuous transversus abdominis plane (TAP) block with IV-PCA in patients undergoing laparoscopic cholecystectomy. The study will add to the evidence base by evaluating postoperative pain management and analgesic needs to reduce opioid-

associated adverse effects of minimally invasive surgery on the abdomen.

Methodology

Study Design: This study was designed as a prospective, randomized, controlled, comparative clinical trial to evaluate and compare the analgesic efficacy of ultrasound-guided single-shot TAP block, continuous TAP block, and intravenous patient-controlled analgesia (IV-PCA) in patients undergoing elective laparoscopic cholecystectomy under general anesthesia.

Study Area: The study was conducted in the Department of Anaesthesia, Medini Rai Medical College and Hospital (MRMCH), Palamu, Jharkhand, India.

Study Duration: The total duration of the study was six months.

Sample Size: A total of 90 patients were enrolled in the study. Patients were randomly allocated into three equal groups of 30 patients each:

- **Group A (IV-PCA group)** – 30 patients
- **Group B (Single-shot TAP block + IV-PCA group)** – 30 patients
- **Group C (Continuous TAP block group)** – 30 patients

Study Population: The study population consisted of adult patients scheduled for elective laparoscopic cholecystectomy under general anesthesia, classified as American Society of Anesthesiologists (ASA) physical status I or II.

Enrollment and Randomization: After obtaining approval from the Institutional Ethics Committee of MRMCH, eligible patients were explained the study protocol and written informed consent was obtained.

Patients were randomly assigned into one of the three groups using a computer-generated random number table. Group allocation was concealed until the time of intervention. Postoperative pain assessments were performed by an investigator blinded to group allocation.

Inclusion Criteria

- Age between 18 and 70 years
- ASA physical status I or II
- Patients scheduled for elective laparoscopic cholecystectomy
- Patients providing written informed consent

Exclusion Criteria

- Known allergy to local anesthetics, opioids, or NSAIDs
- Chronic opioid or analgesic use
- Coagulation disorders
- Infection at the site of block
- Hepatic or renal dysfunction
- Pregnancy or lactation
- Psychiatric illness or cognitive impairment affecting pain assessment
- Neurological deficits involving the abdominal wall

Data Collection: Data were collected using a pre-structured case record form. The recorded variables included demographic characteristics such as age, sex, weight, and ASA status, intraoperative anesthetic details, postoperative pain scores, requirement of rescue analgesia, incidence of postoperative complications, and patient satisfaction scores.

Procedure: All patients received standardized general anesthesia. Premedication consisted of glycopyrrolate 0.003 mg/kg and midazolam 0.05 mg/kg intravenously. Induction of anesthesia was achieved using thiopental sodium 5 mg/kg and remifentanil infusion at 1 μg/kg/min followed by rocuronium 0.8 mg/kg to facilitate endotracheal intubation. Anesthesia was maintained using desflurane with remifentanil infusion, maintaining bispectral index values between 40 and 60.

Patients in Group A received IV-PCA containing oxycodone and ketorolac diluted in normal saline with a basal infusion rate of 1 mL/h, bolus dose of 1 mL, and lockout interval of 15 minutes. Patients in Group B received an ultrasound-guided single-shot TAP block after induction of anesthesia using 20 mL of 0.2% ropivacaine deposited in the fascial plane between the internal oblique and transversus abdominis muscles, followed by IV-PCA similar to Group A. Patients in Group C received an ultrasound-guided continuous TAP block in which 20 mL of 0.2% ropivacaine was administered and a catheter was inserted into the TAP plane, through which continuous infusion was started postoperatively at 3 mL/h with a bolus dose of 4 mL and lockout interval of 30 minutes. The catheter was removed after 48 hours. All blocks were performed by an experienced anesthesiologist under strict aseptic precautions.

Outcome Measures: The primary outcome measure was postoperative pain intensity assessed using the Numeric Rating Scale (NRS) ranging from 0 (no pain) to 10 (worst imaginable pain). Pain scores were recorded at arrival in the post-anesthesia care unit and at 4, 12, 24, 36, and 48 hours postoperatively. Secondary outcomes included requirement of rescue analgesics, incidence of postoperative nausea and vomiting, local anesthetic-related adverse effects, catheter-related complications, and patient satisfaction assessed using a 4-point Likert scale.

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using SPSS software (version 18.0 or later). Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Normality of data distribution was

assessed using the Kolmogorov–Smirnov test. Intergroup comparisons for continuous variables were performed using one-way ANOVA with Bonferroni post-hoc test for normally distributed data and Kruskal–Wallis test for non-parametric data. Categorical variables were analyzed using Chi-square test or Fisher's exact test. A p-value less than 0.05 was considered statistically significant."

Result

Table 1 shows that the demographic characteristics were comparable among the three groups. The mean age was 42.8 ± 11.6 years in Group A, 41.9 ± 12.1 years in Group B, and 43.5 ± 10.8 years in Group C ($p = 0.86$). Gender distribution (M/F) was 18/12 in Group A, 19/11 in Group B, and 13/17 in Group C ($p = 0.91$). Mean body weight was 63.7 ± 7.4 kg, 64.1 ± 6.9 kg, and 65.0 ± 7.1 kg respectively ($p = 0.74$), while BMI was 24.6 ± 2.3, 24.9 ± 2.5, and 25.1 ± 2.2 kg/m² ($p = 0.68$). ASA physical status I/II distribution was 17/13, 16/14, and 18/12 ($p = 0.89$), and duration of surgery was 68.5 ± 9.2 min, 70.1 ± 8.7 min, and 69.3 ± 8.5 min ($p = 0.72$) in Groups A, B, and C respectively. All p-values were >0.05, indicating no statistically significant differences and confirming that the groups were demographically comparable.

Table 1: Demographic Characteristics

Variable	Group A (n=30)	Group B (n=30)	Group C (n=30)	p-value
Age (years)	42.8 ± 11.6	41.9 ± 12.1	43.5 ± 10.8	0.86
Gender (M/F)	18-Dec	19-Nov	13/17	0.91
Weight (kg)	63.7 ± 7.4	64.1 ± 6.9	65.0 ± 7.1	0.74
BMI (kg/m²)	24.6 ± 2.3	24.9 ± 2.5	25.1 ± 2.2	0.68
ASA I/II	17/13	16/14	18/12	0.89
Duration of surgery (min)	68.5 ± 9.2	70.1 ± 8.7	69.3 ± 8.5	0.72

Table 2 demonstrates that postoperative NRS pain scores at rest were consistently highest in Group A, lower in Group B, and lowest in Group C across all observation periods. In the PACU, scores were 5.8 ± 1.1 in Group A, 3.4 ± 1.0 in Group B, and 2.6 ± 0.9 in Group C, and this decreasing pattern continued at 4 hr (5.2 ± 1.2 vs 3.1 ± 0.9 vs 2.3 ± 0.8), 12 hr (4.9 ± 1.0 vs 2.8 ± 0.8 vs 2.0 ± 0.7), 24 hr (4.5 ± 1.1 vs 2.6 ± 0.9 vs 1.9 ± 0.6), 36 hr (4.1 ± 1.0 vs 2.4 ± 0.8 vs 1.7 ± 0.6), and 48 hr (3.8 ± 1.1 vs 2.3 ± 0.7 vs 1.5 ± 0.5). The differences were statistically highly significant at every time point ($p < 0.001$), indicating superior analgesia in Group C followed by Group B, while Group A had the poorest pain control at rest throughout the postoperative period.

Table 2: Postoperative NRS Pain Scores at Rest

Time	Group A	Group B	Group C	p-value
PACU	5.8 ± 1.1	3.4 ± 1.0	2.6 ± 0.9	<0.001
4 hr	5.2 ± 1.2	3.1 ± 0.9	2.3 ± 0.8	<0.001
12 hr	4.9 ± 1.0	2.8 ± 0.8	2.0 ± 0.7	<0.001
24 hr	4.5 ± 1.1	2.6 ± 0.9	1.9 ± 0.6	<0.001
36 hr	4.1 ± 1.0	2.4 ± 0.8	1.7 ± 0.6	<0.001
48 hr	3.8 ± 1.1	2.3 ± 0.7	1.5 ± 0.5	<0.001

Table 3 shows postoperative NRS pain scores on movement were consistently highest in Group A, intermediate in Group B, and lowest in Group C at all time points. In the PACU, scores were 6.6 ± 1.0 in Group A, 4.3 ± 1.1 in Group B, and 3.1 ± 0.9 in Group C, and this trend persisted at 4 hr (6.1 ± 1.2 vs 3.9 ± 1.0 vs 2.9 ± 0.8), 12 hr (5.7 ± 1.1 vs 3.6 ± 0.9 vs 2.6 ± 0.7), 24 hr (5.3 ± 1.2 vs 3.4 ± 0.8 vs 2.4 ± 0.6), 36 hr (4.9 ± 1.1 vs 3.1 ± 0.7 vs 2.2 ± 0.6), and 48 hr (4.5 ± 1.0 vs 2.9 ± 0.8 vs 2.0 ± 0.5). The differences were statistically highly significant at every interval ($p < 0.001$), indicating progressively better pain control from Group A to Group C, with Group C providing the most effective analgesia throughout the postoperative period.

Table 3: Postoperative NRS Pain Scores on Movement

Time	Group A	Group B	Group C	p-value
PACU	6.6 ± 1.0	4.3 ± 1.1	3.1 ± 0.9	<0.001
4 hr	6.1 ± 1.2	3.9 ± 1.0	2.9 ± 0.8	<0.001
12 hr	5.7 ± 1.1	3.6 ± 0.9	2.6 ± 0.7	<0.001
24 hr	5.3 ± 1.2	3.4 ± 0.8	2.4 ± 0.6	<0.001
36 hr	4.9 ± 1.1	3.1 ± 0.7	2.2 ± 0.6	<0.001
48 hr	4.5 ± 1.0	2.9 ± 0.8	2.0 ± 0.5	<0.001

Table 4 demonstrates a significant reduction in postoperative opioid requirement from Group A to Group C over 48 hours. Mean oxycodone consumption was highest in Group A (28.4 ± 6.2 mg), reduced in Group B (18.7 ± 5.1 mg), and lowest in Group C (10.9 ± 4.3 mg) with a highly significant difference ($p < 0.001$). Similarly, the need for rescue analgesia decreased markedly: 21 patients (70%) in Group A, 10 patients (33.3%) in Group B, and only 4 patients (13.3%) in Group C ($p < 0.001$). The time to first rescue analgesic was shortest in Group A (2.1 ± 1.3 hr), longer in Group B (6.8 ± 2.4 hr), and longest in Group C (14.6 ± 4.1 hr), also statistically significant ($p < 0.001$), indicating superior and prolonged analgesic efficacy in Group C compared to Groups A and B.

Table 4: Total Opioid Consumption (48 hr)

Parameter	Group A	Group B	Group C	p-value
Oxycodone (mg)	28.4 ± 6.2	18.7 ± 5.1	10.9 ± 4.3	<0.001
Rescue analgesia required (n, %)	21 (70%)	10 (33.3%)	4 (13.3%)	<0.001
Time to first rescue (hr)	2.1 ± 1.3	6.8 ± 2.4	14.6 ± 4.1	<0.001

Table 5 compares postoperative complications among Groups A, B, and C. Nausea occurred in 12 (40%) of Group A, 6 (20%) of Group B, and 3 (10%) of Group C, showing a significant reduction ($p = 0.02$). Vomiting was also significantly higher in Group A 8 (26.7%) compared with Group B 3 (10%) and Group C 1 (3.3%) ($p = 0.01$). Pruritus was reported in 5 (16.7%), 2 (6.7%), and 1 (3.3%) respectively ($p = 0.18$), and sedation in 6 (20%), 3 (10%), and 2 (6.7%) ($p = 0.29$), both statistically non-significant. No block-related complications were observed in any group. Overall, Groups B and especially C had fewer postoperative adverse effects than Group A.

Table 5: Postoperative Complications

Complication	Group A	Group B	Group C	p-value
Nausea	12 (40%)	6 (20%)	3 (10%)	0.02
Vomiting	8 (26.7%)	3 (10%)	1 (3.3%)	0.01
Pruritus	5 (16.7%)	2 (6.7%)	1 (3.3%)	0.18
Sedation	6 (20%)	3 (10%)	2 (6.7%)	0.29
Block complications	0	0	0	—

Table 6 shows patient satisfaction scores across three groups (A, B, C) using a 4-point Likert scale and demonstrates a significant difference ($p < 0.001$). Poor satisfaction was highest in Group A 6 (20%), minimal in Group B 1 (3.3%), and absent in Group C. Fair satisfaction occurred in 12 (40%) of Group A, 6 (20%) of Group B, and 2 (6.7%) of Group C. Good satisfaction was reported by 9 (30%) in Group A, 13 (43.3%) in Group B, and 8 (26.7%) in Group C. Excellent satisfaction was predominantly seen in Group C 20 (66.7%), followed by Group B 10 (33.3%), and least in Group A 3 (10%). Overall, patient satisfaction improved progressively from Group A to Group C.

Table 6: Patient Satisfaction Score (4-point Likert)

Satisfaction	Group A	Group B	Group C	p-value
Poor	6 (20%)	1 (3.3%)	0	<0.001
Fair	12 (40%)	6 (20%)	2 (6.7%)	
Good	9 (30%)	13 (43.3%)	8 (26.7%)	
Excellent	3 (10%)	10 (33.3%)	20 66.7%)	

Discussion

Our study found that the three groups had similar baseline demographic traits, which proved that there was sufficient randomization and reduced the confounding effect of analgesic outcomes. The same comparability has been described in randomized trials comparing TAP block in the post- laparoscopic cholecystectomy group, in which, age, sex distribution, and surgical duration did not differ statistically between groups (Petersen et al., 2012; Ra et al., 2010) [12,13]. The peri-operative variables are similar, and this enables the internal validity of our findings and enables the attribution of postoperative analgesic differences to the analgesic technique itself and not patient characteristics."

As the results of our study have shown, the level of postoperative pain in the continuous TAP block group was yielding significantly low scores at rest and during movement over the 48 hours. As an example, PACU resting pain was 2.6 +/- 0.9 versus 3.4 +/- 1.0 in single-shot group versus IV-PCA and 1.9 +/- 0.6, 2.6 +/- 0.9 and 4.5 +/- 1.1 at 24 hours respectively. These findings are in line with earlier research findings that indicate that TAP block will be

significantly beneficial in providing somatic analgesia following laparoscopic cholecystectomy (El-Dawlatly et al., 2009; McDonnell et al., 2007) [4,6]. Nevertheless, our research also proves to be better and prolonged analgesia with continuous catheter infusion than single-shot technique, which confirms the idea that TAP block is of limited effect over time, which is short with single-shot method. Stokving et al. (2015) [9] demonstrated that even with excellent dermatomal coverage, the length of one TAP block was short-lived and therefore highlighted why the pain in single-shot group increased gradually in our study after the early postoperative phase. On the other hand, the continuous infusion ensures that the local anesthetic concentration is maintained in the transversus abdominis plane, which increases somatic analgesia (Kadam and Field, 2011; Farag et al., 2015) [11,10].

The extent of pain during movement was always greater than pain at rest in all the groups, but the lowest one was observed in the continuous TAP group (PACU 3.1 ± 0.9 vs 4.3 ± 1.1 vs 6.6 ± 1.0). This observation is consistent with the established pathophysiology of laparoscopic cholecystectomy pain, comprising somatic incisional and visceral elements worsened by motion (Bisgaard et al., 2001) [14]. Past studies show that TAP block is mostly beneficial in reducing somatic and not visceral pain (Gupta, 2005) [8]. Our results indirectly prove this process: even after constant TAP block, the pain of movement decreased considerably, but it did not disappear, indicating the presence of some visceral pain, as it had been previously discussed (Ra et al., 2010) [13]. Thus, it is possible to state that TAP block is used as a complementary method of multimodal analgesia and not as an alternative to systemic analgesics (Kehlet and Dahl, 1993) [1].

There was a drastic decrease in the consumption of opioids in our study in the continuous TAP group (10.9 ± 4.3 mg) in contrast to the single-shot (18.7 ± 5.1 mg) and IV-PCA (28.4 ± 6.2 mg). Similar results of opioid sparing have been consistently reported in TAP block trials, where it was observed to reduce opioid by approximately 3050 percent (Petersen et al., 2012; McDonnell et al., 2007) [12,6]. The larger effect of our continuous group is in favor of the hypothesis that further opioid use has a greater reduction in the central sensitization and opioid requirement. In addition, the long duration of the first analgesic request (14.6 ± 4.1 h vs 6.8 ± 2.4 h vs 2.1 ± 1.3 h) is also indicative of the previous studies which found that TAP block increased the delay of the initial analgesic request significantly (El-Dawlatly et al., 2009) [4]. This prolonged analgesia enhances fast healing and could assist in ambulatory surgery regimes.

TAP block also led to fewer cases of postoperative complications (particularly nausea and vomiting 10% vs 20% vs 40%). Such results align with systematic reviews that show more adverse effects on opioid use with IV-PCA (Walder et al., 2001) [15]. The opioid-sparing effect of TAP block is the reason why postoperative nausea and vomiting occurred less frequently in our group of continuous. The same study mentioned that there were fewer opioid-associated complications and better recovery with the use of TAP block as part of multimodal analgesia (Petersen et al., 2012) [12]. We also lack block-related complications, which is also in line with the literature that showed low systemic toxicity because of low vascularity of the transversus abdominis plane (McDonnell et al., 2008) [16] in the study.

The continuous TAP group had the greatest level of patient satisfaction, and the level of patient satisfaction was excellent in 66.7% when compared to 33.3% in single-shot and 10% in IV-PCA groups. Effective analgesia and few adverse effects are strongly associated with satisfaction (Hudak and Wright, 2000) [17]. Such positive changes in the overall patient satisfaction with TAP block versus systemic opioids have been reported previously (Ra et al., 2010) [13]. Less nausea, decreased pain rating, and increased comfort time were probably some of the factors that were associated with better recovery perception among our patients.

Altogether, our findings correspond to the existing evidence that TAP block is an effective analgesic modality in laparoscopic cholecystectomy but additionally indicate that continuous catheter-based TAP block demonstrates the best analgesia and opioid sparing than single-shot TAP block and IV-PCA, individually. Although previous researchers hypothesized that TAP block would be similar to IV-PCA in terms of somatic analgesia (Petersen et al., 2012) [12], our results suggest that the continuous infusion will be extended and superior. Thus, continuous TAP block can be a more favorable multimodal analgesic approach, as it combines the effectiveness of somatic pain control with fewer negative effects of opioids, but high satisfaction rates of patients.

Conclusion

The current research shows that ultrasound-guided transversus abdominis plane (TAP) block is a better postoperative analgesic method than intravenous patient-controlled analgesic method when general laparoscopic cholecystectomy is performed. Both versions of TAP method proved more efficient during rest and movement, the reduction of opioid needs, postponement of rescue analgesia demand, and opioid-associated adverse reactions. Continuous TAP block as one of the two regional methods provided the best sustained analgesia with a high degree of patient satisfaction, whereas single-shot TAP block had mediocre efficacy. The technique is also safe as evidenced by the lack of complications related to the block. In the whole scenario, continuous TAP block

seems to be the most efficient modality of multimodal postoperative pain in laparoscopic cholecystectomy patients.

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