



EFFECT OF ULTRASOUND-GUIDED EXTERNAL OBLIQUE INTERCOSTAL FASCIAL PLANE BLOCK ON HOSPITAL LENGTH OF STAY AND POSTOPERATIVE ANALGESIA IN GERIATRIC PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract

Background: Effective postoperative pain management in geriatric patients undergoing laparoscopic cholecystectomy is essential to facilitate early recovery, reduce opioid-related adverse effects, and shorten hospital stay. The ultrasound-guided external oblique intercostal fascial plane (EOIC) block is a novel regional anaesthetic technique that provides analgesia to the upper abdominal wall by blocking the anterior and lateral cutaneous branches of the thoracoabdominal nerves. This prospective randomized controlled trial evaluated the effect of bilateral EOIC block on hospital length of stay and postoperative analgesia in geriatric patients undergoing laparoscopic cholecystectomy. Sixty patients aged ≥ 65 years were randomly allocated to receive either bilateral ultrasound-guided EOIC block with 0.25% levobupivacaine and dexamethasone (Group E, n=30) or bilateral normal saline (Group C, n=30) following induction of general anaesthesia. The primary outcomes were hospital length of stay and postoperative visual analogue scale (VAS) pain scores during the first 24 hours. Secondary outcomes included postoperative opioid consumption and perioperative haemodynamic parameters. Patients receiving EOIC block demonstrated significantly lower postoperative VAS scores from 16 to 24 hours and a significantly shorter hospital length of stay than the control group ($p < 0.05$). Postoperative opioid consumption was also lower in the EOIC group. Ultrasound-guided EOIC block appears to be an effective adjunct to multimodal analgesia in geriatric patients undergoing laparoscopic cholecystectomy and may facilitate enhanced recovery and earlier hospital discharge.

Key Words: External oblique intercostal fascial plane block; laparoscopic cholecystectomy; geriatric patients; regional anaesthesia; enhanced recovery after surgery.

Introduction

Laparoscopic cholecystectomy is the gold standard surgical treatment for symptomatic gallstone disease and remains one of the most frequently performed abdominal procedures worldwide. Although considered minimally invasive, postoperative pain following laparoscopic cholecystectomy remains clinically significant and is multifactorial in origin, resulting from trocar-site trauma, visceral manipulation, pneumoperitoneum, and diaphragmatic irritation. Inadequately controlled postoperative pain delays mobilization, increases opioid consumption, prolongs hospital stay, and negatively affects postoperative recovery.¹

The geriatric population poses unique perioperative challenges because of age-related physiological changes, reduced functional reserve, and the high prevalence of associated comorbidities. Older patients are particularly susceptible to opioid-related adverse effects such as respiratory depression, postoperative nausea and vomiting, excessive sedation, delirium, constipation, and delayed mobilization. Consequently, optimizing postoperative analgesia while minimizing systemic opioid exposure has become an important objective in perioperative care for elderly surgical patients.²

Enhanced Recovery After Surgery (ERAS) protocols advocate multimodal analgesia as a cornerstone of perioperative management to facilitate early ambulation, reduce postoperative complications, shorten hospital length of stay, and improve patient satisfaction. Regional anaesthesia techniques have therefore become increasingly important components of multimodal analgesic strategies because they provide effective pain relief while reducing perioperative opioid requirements and their associated adverse effects.³

Among the available regional anaesthesia techniques, ultrasound-guided fascial plane blocks have gained considerable attention because of their simplicity, favourable safety profile, and reproducibility. Several fascial plane blocks, including the transversus abdominis plane (TAP) block, quadratus lumborum block, and erector spinae plane block, have been investigated for postoperative analgesia following upper abdominal surgery with varying degrees of success. Recent PROSPECT recommendations continue to support procedure-specific multimodal analgesia while recognising the evolving role of regional anaesthesia in selected patients undergoing laparoscopic cholecystectomy.¹

The external oblique intercostal fascial plane (EOIC) block is a relatively novel ultrasound-guided regional anaesthetic technique first described by Elsharkawy et al. The block is performed by depositing local anaesthetic in the fascial plane between the external oblique and external intercostal muscles at approximately the sixth or seventh rib. Cadaveric evaluation demonstrated reliable spread of injectate to the anterior and lateral cutaneous branches of the thoracoabdominal nerves (T6–T10), thereby providing sensory blockade of the upper anterolateral abdominal wall relevant to upper abdominal surgical procedures.⁴ The anatomical basis and ultrasound-guided technique of the EOIC block are illustrated in Figure 1.

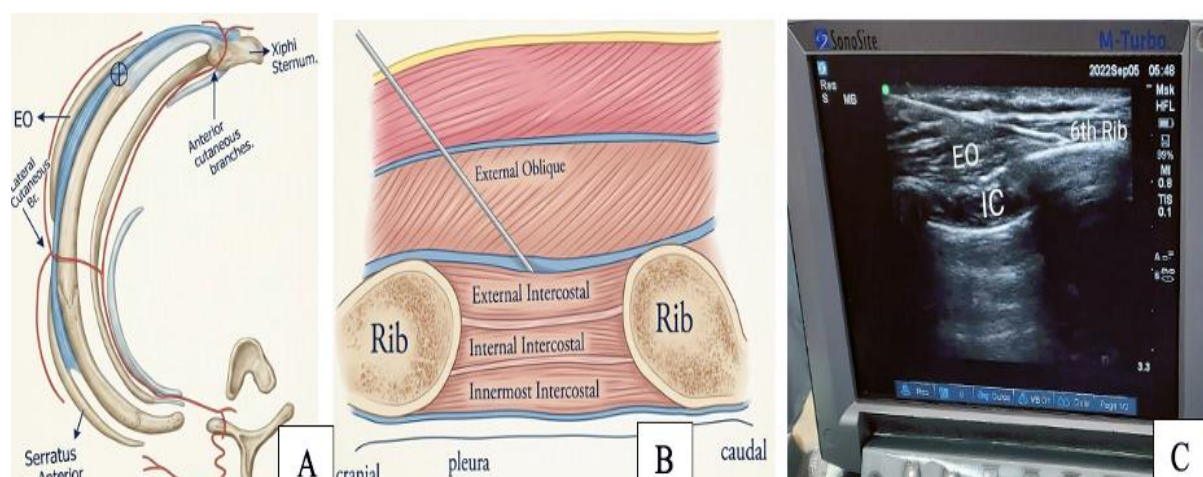


Figure 1. Ultrasound-guided external oblique intercostal fascial plane (EOIC) block. (A) Schematic illustration demonstrating the anatomical basis of the EOIC block and the distribution of the anterior and lateral cutaneous branches of the thoracoabdominal intercostal nerves supplying the upper anterior abdominal wall. (B) Illustration of the ultrasound-guided EOIC block showing in-plane needle insertion and deposition of local anaesthetic within the fascial plane between the external oblique and external intercostal muscles. (C) Representative ultrasound image demonstrating the sonoanatomy of the EOIC block at the sixth rib level, with visualization of the external oblique muscle (EO), external intercostal muscle (IC), and rib.

Following its anatomical description, clinical application of the EOIC block has been reported in upper abdominal surgeries, with preliminary evidence suggesting improved postoperative analgesia and reduced opioid requirements. However, the available literature is largely limited to case reports, case series, and small clinical studies, and evidence regarding its efficacy in geriatric patients undergoing laparoscopic cholecystectomy remains limited.⁵

Considering the growing emphasis on opioid-sparing analgesia and ERAS pathways in elderly surgical patients, further evaluation of the EOIC block is warranted. Therefore, the present prospective randomized controlled trial was undertaken to evaluate the effect of ultrasound-guided bilateral external oblique intercostal fascial plane block on postoperative pain and hospital length of stay in geriatric patients undergoing laparoscopic cholecystectomy. We hypothesized that the addition of bilateral EOIC block to standard general anaesthesia would provide superior postoperative analgesia and facilitate earlier hospital discharge compared with standard perioperative analgesic management.

Methods

Study Design And Ethical Approval

This prospective randomized controlled trial was conducted in the Department of Anaesthesiology, Narayana Medical College, Nellore, Andhra Pradesh, India, over a period of four months after obtaining approval from the Institutional Ethics Committee. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrolment.

Study Population

Sixty geriatric patients aged 65 years or older scheduled to undergo elective laparoscopic cholecystectomy under general anaesthesia were enrolled in the study. Eligible patients belonged to the American Society of Anesthesiologists (ASA) physical status I–III.

Sample Size and Randomization

A total of 60 patients were enrolled and randomly allocated in a 1:1 ratio using a simple randomization technique into two groups (n = 30 each). Group E received bilateral ultrasound-guided external oblique intercostal fascial plane (EOIC) block with 25 mL of 0.25% levobupivacaine plus 8 mg dexamethasone on each side, while Group C received 25 mL of normal saline bilaterally.

Inclusion Criteria

- ☐ Patients aged ≥ 65 years.
- ☐ ASA physical status I–III.
- ☐ Patients scheduled for elective laparoscopic cholecystectomy under general anaesthesia.
- ☐ Ability to understand the study protocol and provide written informed consent.

Exclusion Criteria

- ☐ Patient refusal.
- ☐ Local infection at the proposed injection site.

- ☐ Known allergy to local anaesthetic drugs.
- ☐ Bleeding diathesis or ongoing anticoagulant therapy.
- ☐ ASA physical status IV or higher.

Anaesthetic Protocol

Standard monitoring, including electrocardiography, non-invasive blood pressure measurement, pulse oximetry, and capnography, was instituted upon arrival in the operating room. General anaesthesia was administered according to the institutional protocol. Following induction of anaesthesia, patients received the allocated intervention before surgical incision. Intraoperative haemodynamic parameters were monitored continuously throughout the procedure.

External Oblique Intercostal Fascial Plane Block Technique

The EOIC block was performed under strict aseptic precautions using ultrasound guidance. A high-frequency linear ultrasound transducer was placed in a parasagittal orientation at the level of the sixth to seventh ribs. The external oblique muscle and external intercostal muscle were identified, and a block needle was advanced using an in-plane approach. Following negative aspiration, the study solution was injected into the fascial plane between the external oblique and external intercostal muscles, with confirmation of adequate hydrodissection. The procedure was repeated contralaterally using the same technique. The ultrasound-guided technique and relevant sonoanatomy are illustrated in Figure 1.

Outcome Measures

Primary Outcomes

- ☐ Hospital length of stay (days).
- ☐ Postoperative pain assessed using the Visual Analogue Scale (VAS) during the first 24 postoperative hours.

Secondary Outcomes

- ☐ Postoperative opioid consumption.
- ☐ Perioperative haemodynamic parameters.
- ☐ Demographic characteristics.
- ☐ ASA physical status.

VAS scores were recorded immediately after surgery and at predefined postoperative intervals of 30 minutes, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 hours.

Statistical Analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages. Continuous variables were compared using the independent-samples t-test, and categorical variables were analysed using the Chi-square test or Fisher's exact test, where appropriate. A two-tailed p value <0.05 was considered statistically significant.

Results

Patient Recruitment

A total of 60 patients were assessed for eligibility and enrolled in the study. All patients fulfilled the inclusion criteria and were randomized equally into two groups: Group E (EOIC block, n=30) and Group C (control, n=30). No patients were excluded after randomization, lost to follow-up, or discontinued the intervention. Consequently, all randomized patients were included in the final analysis (Figure 2).

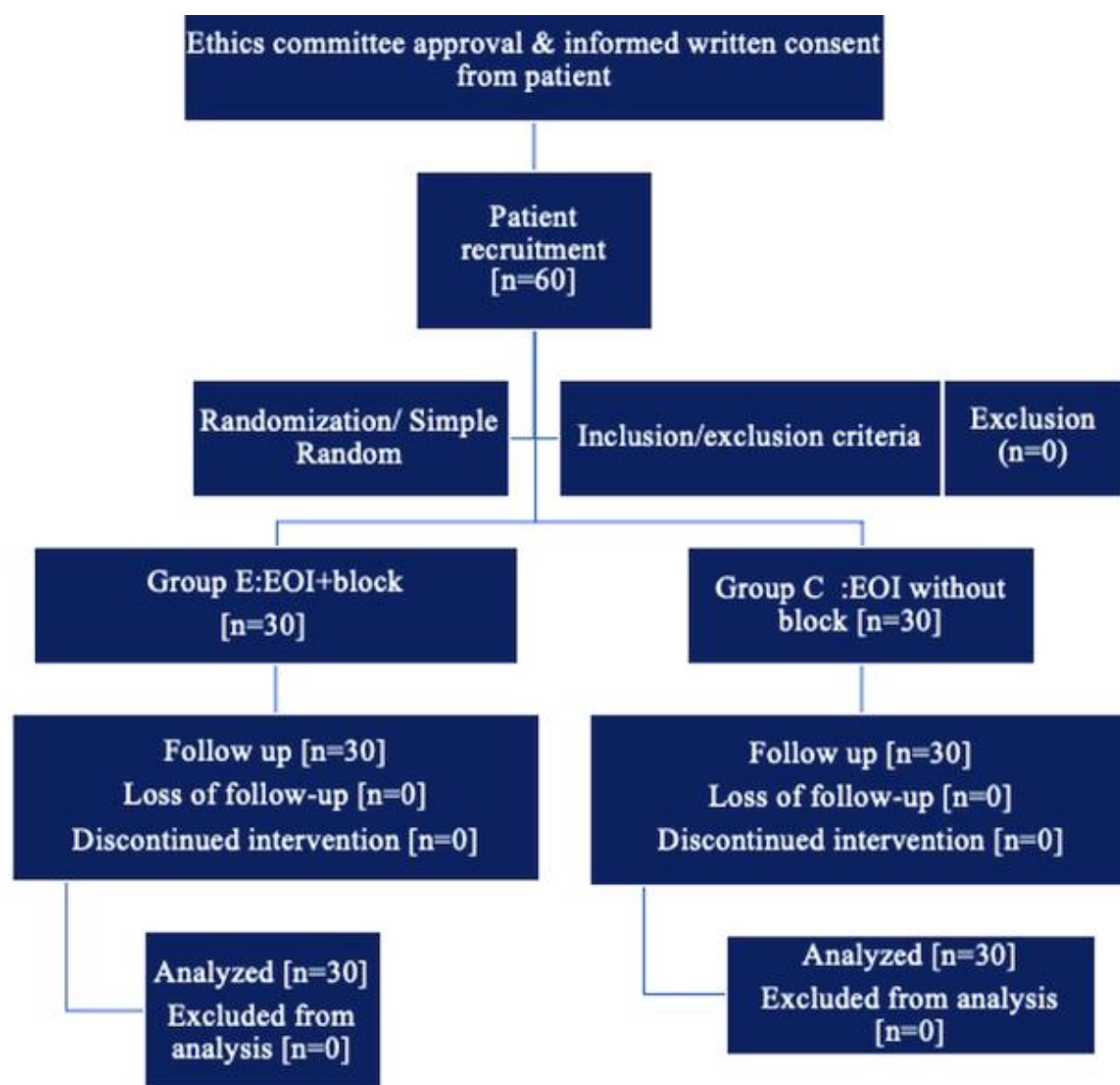


Figure 2 : CONSORT patient flow diagram

Baseline Characteristics

The demographic and preoperative characteristics of both groups were comparable. There were no statistically significant differences between Group E and Group C with respect to age, sex distribution, ASA physical status, height, or body weight ($p > 0.05$ for all variables). The baseline characteristics of the study population are summarized in Table 1.

Table 1 : Baseline demographic and clinical characteristics.

Characteristics	GROUP C (n=30) Mean±SD	GROUP E (n=30) Mean±SD	p value
Age (years)	65.9±5.98	66.55±4.45	0.126
Gender(M/F)	10/20	14/16	0.2
ASA (I/II/III)	3/10/17	4/9/17	0.35
Height (cm)	159.62±4.11	159.15±3.716	0.79
Body weight (range)kg	64.93± 5.1[60-69]	65.55± 4.42[61-71]	0.25

Postoperative Pain Scores

Postoperative VAS scores were comparable between the two groups during the early postoperative period. However, from the 16th postoperative hour onwards, patients receiving the EOIC block demonstrated significantly lower VAS scores compared with the control group. Statistically significant differences were observed at 16 hours ($p=0.03$), 18 hours ($p=0.04$), 20 hours ($p=0.02$), 22 hours ($p=0.001$), and 24 hours ($p=0.002$). The temporal trend of postoperative pain scores is presented in Table 2 and illustrated in Figure 3.

Table 2 : Postoperative VAS scores at each assessment time point.

Time interval	GROUP C (n=30)		GROUP E (n=30)		p value
	Mean	SD	Mean	SD	
Immediate 0 Hr	0	-	0	-	-
-30 min	0	-	0	-	-
2 hr	1.0	-	0	-	-
4 hr	1.0	-	0	-	-
6 hr	2.0	1.2	0	-	-
8 hr	2.0	0.9	1	-	-
10 hr	2.0	1.0	1	-	-
12 hr	2.2	0.8	1	-	-
14 hr	2.2	1.2	1	-	-
16 hr	2.4	1.5	1.2	0.2	0.03
18 hr	2.6	1.4	1.5	0.5	0.04
20 hr	2.6	1.2	1.6	0.6	0.02
22 hr	2.8	1.8	2.0	1.2	0.001
After 24 hr	3	2.5	2.0	1.3	0.002

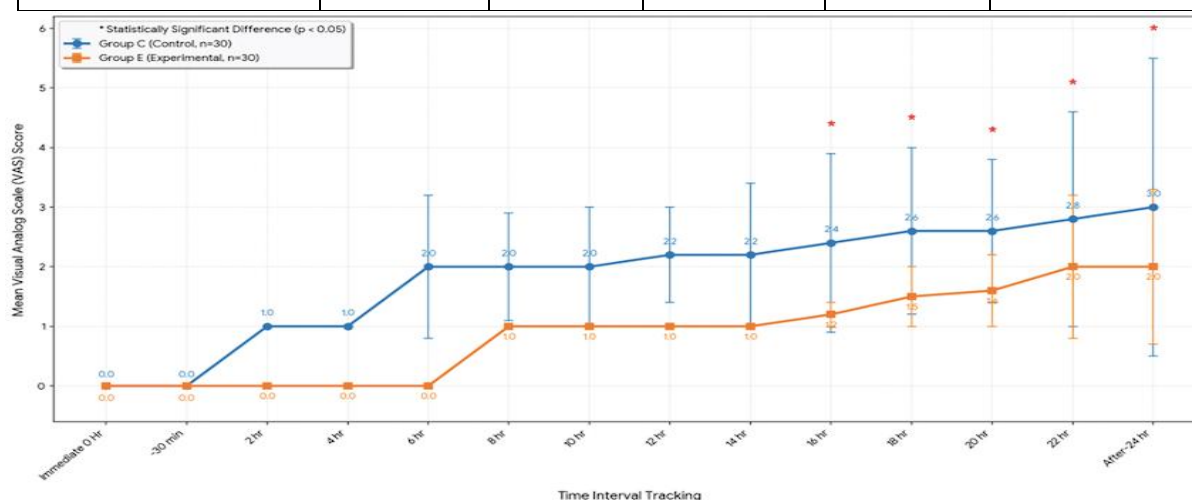


Figure 3 : Line graph of postoperative VAS scores over 24 hours.

Length of Hospital Stay

Patients who received the EOIC block had a significantly shorter hospital length of stay compared with the control group. The mean hospital stay was 1.0 ± 1.2 days in Group E compared with 2.0 ± 1.6 days in Group C ($p=0.04$), indicating improved postoperative recovery in patients receiving ultrasound-guided EOIC block (Table 3, Figure 4).

Table 3 : Primary and secondary outcomes (length of stay, opioid consumption if available, and any complications).

Parameters	Group C	Group E	P Value
Surgery time (range) minutes	69.8±19.5 (60-120)	71.2±17.5 (62-120)	0.12
Mean length of stay (day)	2.0 ±1.6	1.0 ± 1.2	0.04
Intraoperative MAP (mm Hg)	86(80-100)	89(75-100)	0.24
Intraoperative HR (bpm)	82.5 (62-92)	77.2 (60- 94)	0.4
Mean time of rescue analgesia (Hr)	12.5± 6.5	24.5± 10.2	0.0001
Total dose of opioid consumption (mg)	155±40.45	110± 64.87	0.002
24 Hr VAS score	3.0±2.5	2.0 ±1.3	0.002

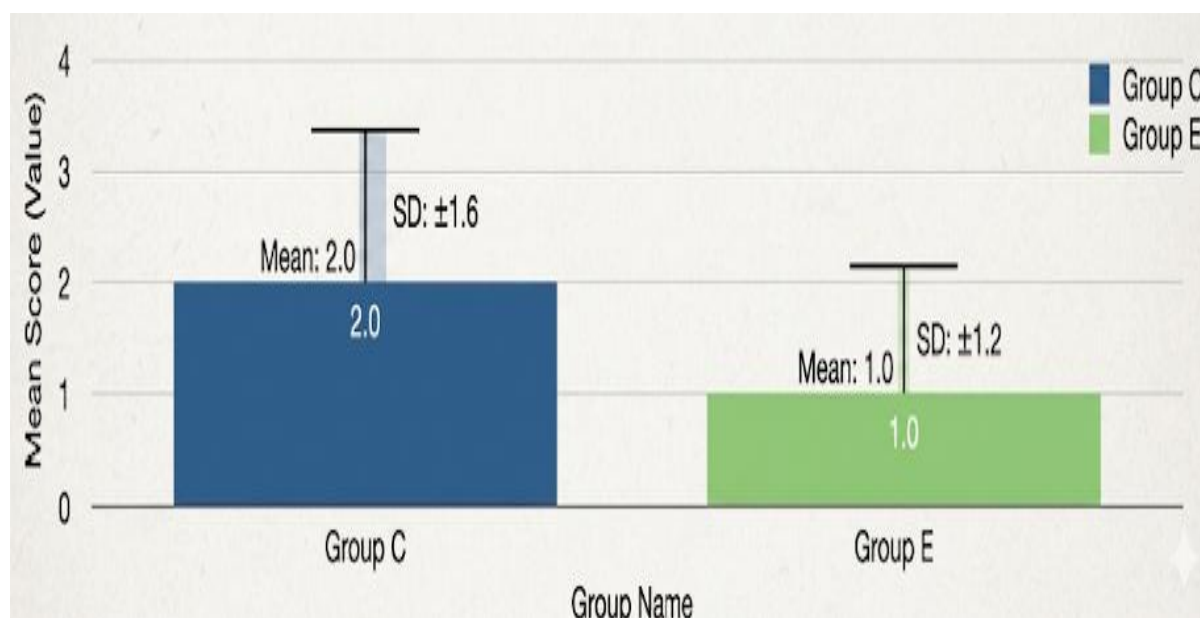


Figure 4 : Bar graph comparing hospital length of stay (LOS) between the two groups

Secondary Outcomes

Postoperative opioid consumption was lower in the EOIC group compared with the control group. Intraoperative and postoperative haemodynamic parameters remained clinically stable in both groups, with no significant haemodynamic instability observed throughout the study period. No block-related complications or adverse events were encountered.

Discussion

Effective postoperative pain management remains an essential component of perioperative care following laparoscopic cholecystectomy, particularly in elderly patients in whom inadequate analgesia may delay ambulation, prolong hospitalization, and increase the incidence of opioid-related adverse effects. The present prospective randomized controlled trial evaluated the efficacy of ultrasound-guided bilateral external oblique intercostal fascial plane (EOIC) block as an adjunct to multimodal analgesia in geriatric patients undergoing laparoscopic cholecystectomy. The principal findings of this study demonstrated that patients receiving EOIC block experienced significantly lower postoperative pain scores during the late postoperative period together with a significantly shorter hospital length of stay when compared with patients receiving placebo block.

The postoperative pain following laparoscopic cholecystectomy is multifactorial, comprising somatic pain from abdominal wall incisions, visceral pain resulting from gallbladder dissection, and referred shoulder pain secondary to diaphragmatic irritation. Consequently, multimodal analgesia using regional anaesthesia techniques has become an important strategy for reducing perioperative opioid consumption while facilitating enhanced postoperative recovery. Current PROSPECT recommendations advocate procedure-specific multimodal analgesia and recognize the role of regional anaesthesia in selected patients undergoing laparoscopic cholecystectomy.¹

The anatomical rationale of the EOIC block supports its use in upper abdominal surgery. Elsharkawy et al. first described the technique and demonstrated, through cadaveric dye injection studies, consistent spread of injectate along the anterior and lateral cutaneous branches of the thoracoabdominal nerves from approximately T6 to T10.⁴ This pattern of spread provides effective somatic analgesia over the upper anterior abdominal wall, corresponding closely to the dermatomes involved during laparoscopic cholecystectomy.

Our findings are consistent with the preliminary clinical experience reported by Coşarcan and Erçelen, who described successful postoperative analgesia following EOIC block in patients undergoing upper abdominal procedures.⁵ Similarly, White and Ji demonstrated the feasibility of EOIC block in obese patients undergoing upper abdominal surgery, highlighting its technical simplicity and favourable sonographic visualization.⁶ Although these reports consisted primarily of case series and case reports, they collectively suggested that EOIC block may reduce postoperative pain while minimizing opioid requirements. The present randomized controlled trial extends these observations by providing comparative evidence in a geriatric population undergoing laparoscopic cholecystectomy.

A notable finding of the present study was the significant reduction in postoperative VAS scores from the sixteenth postoperative hour onwards in the EOIC group. This sustained analgesic effect may be attributed to prolonged spread of local anaesthetic within the fascial plane together with the addition of dexamethasone as an adjuvant, which has been shown to prolong the duration of peripheral nerve blocks. Improved postoperative analgesia probably contributed to earlier mobilization and the significantly shorter hospital stay observed in patients receiving EOIC block.

Reduction of opioid exposure is particularly important in elderly patients because opioid-related adverse effects such as postoperative nausea and vomiting, respiratory depression, excessive sedation, urinary retention, constipation, and postoperative delirium may substantially impair recovery. Although the present study primarily evaluated postoperative pain and hospital length of stay, the observed improvement in analgesia supports the role of EOIC block as part of an opioid-sparing multimodal analgesic strategy within ERAS pathways.

The present study has several strengths. It is among the early prospective randomized studies evaluating EOIC block in geriatric patients undergoing laparoscopic cholecystectomy. All blocks were performed under ultrasound guidance using a standardized technique, thereby improving procedural consistency. Furthermore, clinically relevant outcomes including postoperative pain and hospital length of stay were evaluated, both of which are important indicators of recovery following minimally invasive surgery.

Nevertheless, certain limitations should be acknowledged. The study was conducted at a single institution with a relatively small sample size, which may limit the generalizability of the findings. Long-term postoperative outcomes and patient-reported quality-of-recovery measures were not assessed. Additionally, although postoperative opioid consumption was included as a secondary outcome, detailed quantitative analysis was limited. Future multicentre randomized controlled trials with larger sample sizes and longer follow-up are required to further establish the efficacy, safety, and role of EOIC block within ERAS protocols for upper abdominal surgery.

Overall, the findings of the present study suggest that ultrasound-guided EOIC block is a promising regional anaesthetic technique that provides effective postoperative analgesia and facilitates earlier hospital discharge in elderly patients undergoing laparoscopic cholecystectomy. Its ease of performance, favourable safety profile, and compatibility with multimodal analgesia make it an attractive option for incorporation into contemporary perioperative practice.

Conclusion

Ultrasound-guided bilateral external oblique intercostal fascial plane (EOIC) block is an effective adjunct to multimodal analgesia in geriatric patients undergoing laparoscopic cholecystectomy. In the present study, EOIC block provided superior postoperative analgesia during the late postoperative period and significantly reduced hospital length of stay compared with the control group. These findings support the incorporation of EOIC block into Enhanced Recovery After Surgery (ERAS) protocols as an opioid-sparing regional anaesthetic technique for elderly patients undergoing upper abdominal laparoscopic surgery. Larger multicentre randomized controlled trials are warranted to further validate these findings and establish its role in routine perioperative practice.

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Abbreviations

Abbreviation	Full Form
ASA	American Society of Anesthesiologists
EO	External Oblique Muscle
EOIC	External Oblique Intercostal Fascial Plane

EOIC Block	External Oblique Intercostal Fascial Plane Block
ERAS	Enhanced Recovery After Surgery
HR	Heart Rate
IC	External Intercostal Muscle
IEC	Institutional Ethics Committee
LOS	Length of Hospital Stay
MAP	Mean Arterial Pressure
PCA	Patient-Controlled Analgesia
RCT	Randomized Controlled Trial
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
VAS	Visual Analogue Scale

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No external funding was received for this study.

Conflict Of Interest

The authors declare that there are no conflicts of interest related to this study.

Author Contributions

Dr. Soma Srikanth: Conceptualization, patient recruitment, data collection, statistical analysis, manuscript preparation.

Dr. Krishna Chaithanya: Study supervision, methodology, critical revision of the manuscript, and final approval of the version submitted for publication.

Ethical Approval

The study was approved by the Institutional Ethics Committee of Narayana Medical College, Nellore, Andhra Pradesh, India. Written informed consent was obtained from all participants prior to enrolment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Data Availability Statement

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

