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TO COMPARE THE EFFICACY OF ULTRASOUND-GUIDED ERECTOR SPINAE PLANE (ESP) BLOCK AND EXTERNAL OBLIQUE INTERCOSTAL FASCIAL PLANE (EOI) BLOCK IN MANAGING POSTOPERATIVE PAIN AND IMPROVING THE QUALITY OF RECOVERY IN ADULT PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY

Anaesthesiology

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ABSTRACT

Background: Ultrasound-guided interfascial plane blocks such as erector spinae plane block (ESPB) and external oblique intercostal fascial plane block (EOIPB) are increasingly used for postoperative pain management after laparoscopic cholecystectomy. **Objective:** To compare the analgesic efficacy of ESPB and EOIPB in patients undergoing laparoscopic cholecystectomy under general anaesthesia.**Materials and Methods:** This prospective observational study was conducted in the Department of Anaesthesiology and Critical Care Medicine, BRD Medical College, Gorakhpur, over 12 months. Sixty adult patients undergoing laparoscopic cholecystectomy under general anaesthesia were included and divided into two groups: Group A received bilateral ESPB and Group B received bilateral EOIPB (30 patients each). Postoperative pain was assessed using the Numeric Rating Scale (NRS) at 0, 1, 6, 12, 18, and 24 hours. Time to first rescue analgesia, total fentanyl consumption, modified Aldrete score, and complications were also recorded.**Results:** Patients in the ESPB group had significantly lower NRS scores at 0, 1, 6, and 12 hours postoperatively compared to the EOIPB group ($p<0.05$). The mean time to first rescue analgesia was significantly longer in Group A (108.0 ± 45.2 minutes) than Group B (80.0 ± 40.5 minutes) ($p=0.014$). Total postoperative fentanyl consumption was significantly lower in the ESPB group (11.5 ± 23.4 mg vs 56.3 ± 74.7 mg; $p=0.003$). Recovery scores and complication rates were comparable between groups.**Conclusion:** Both ESPB and EOIPB were safe and effective for postoperative analgesia following laparoscopic cholecystectomy. However, ESPB provided superior early postoperative pain relief, prolonged analgesia, and reduced opioid consumption.

KEYWORDS

Erector Spinae Plane Block; Laparoscopic Cholecystectomy; Postoperative Pain; Regional Anaesthesia; Ultrasonography

INTRODUCTION

Laparoscopic cholecystectomy (LC) is one of the most commonly performed abdominal surgeries and requires effective multimodal analgesia (MMA) for management of postoperative pain. Pain after LC is multifactorial and may arise from pneumoperitoneum, surgical manipulation of the viscera, peritoneal stretching, and port-site incisions. Inadequate postoperative pain control may lead to patient dissatisfaction, delayed mobilization, prolonged hospital stay, increased healthcare costs, and development of chronic pain syndromes.[1] Therefore, effective postoperative pain management remains an important challenge for anaesthesiologists.

In recent years, ultrasound-guided interfascial plane blocks have gained popularity as components of MMA because of their safety, simplicity, and opioid-sparing effects. The use of ultrasound allows accurate identification of fascial planes and precise deposition of local anaesthetic, thereby improving block efficacy and reducing complications. Among these techniques, the External Oblique Intercostal (EOI) fascial plane block and the Erector Spinae Plane Block (ESPB) are increasingly being used for upper abdominal surgeries.[2,3]

The ultrasound-guided EOI fascial plane block, first described by Hashim et al., is a modification of the transversus abdominis plane block and provides analgesia to the upper anterior abdominal wall by targeting the intercostal nerves from T6 to T10.[4] A study by Breazu CM et al. shown that EOI block reduces postoperative pain scores and decreases postoperative analgesic requirements without causing significant complications or local anaesthetic toxicity.[5]

The ESPB, first introduced by Forero et al., is a novel interfascial plane block in which local anaesthetic is injected deep to the erector spinae muscle adjacent to the transverse process. The injected local anaesthetic spreads cranially and caudally over multiple dermatomes, providing effective analgesia by blocking the dorsal and ventral rami of spinal nerves.[6] ESPB has been effectively used for postoperative pain management following thoracic, abdominal, and orthopedic surgeries.[7]

Despite the increasing use of ESPB and EOI block in laparoscopic surgeries, direct comparative studies between these two techniques in patients undergoing LC remain limited.[1,8] Although several studies have evaluated the analgesic efficacy of ESPB and EOI block individually, evidence comparing their effectiveness specifically for laparoscopic cholecystectomy in the Indian population is scarce.[9-11] Therefore, the present study was undertaken to compare the efficacy of ultrasound-guided ESPB and EOI block for postoperative pain management in adult patients undergoing laparoscopic cholecystectomy. We hypothesized that bilateral ESPB would provide longer duration of analgesia, reduced opioid consumption, and lower postoperative pain scores compared to bilateral EOI block.

Material and Methods

Study design and setting

This prospective observational study was conducted in the Department of Anaesthesiology and Critical Care Medicine, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India, over a period of 12 months. The study compared the efficacy of ultrasound-guided erector spinae plane block (ESPB) and external oblique intercostal fascial plane block (EOIPB) for postoperative pain management in patients undergoing laparoscopic cholecystectomy.

Study population

A total of 60 adult patients scheduled for elective laparoscopic cholecystectomy under general anaesthesia were included in the study and alternatively allocated into two groups:

Group A: ESPB group (n=30)
Group B: EOIPB group (n=30)

Inclusion criteria

- Age between 18–60 years
- ASA physical status I or II
- Scheduled for laparoscopic cholecystectomy

Exclusion criteria

- Patient refusal
- Contraindications to regional anaesthesia

- Severe cardiovascular or neurological disease
- Chronic opioid use or substance abuse

Study procedure
After obtaining Institutional Ethics Committee approval and written informed consent, all patients underwent standard general anaesthesia. Routine monitoring was applied, and patients received intravenous glycopyrrolate, midazolam, fentanyl, propofol, and vecuronium.

In Group A, bilateral ESPB was performed at the T7/T8 level using 20 mL of 0.25% bupivacaine on each side. In Group B, bilateral EOIPB was administered between the external oblique and intercostal muscles at the level of the sixth rib using 20 mL of 0.25% bupivacaine on each side.

Postoperative pain was assessed using the Numeric Rating Scale (NRS) at 0, 1, 6, 12, 18, and 24 hours after surgery. Intravenous fentanyl (1 µg/kg) was administered as rescue analgesia when NRS score exceeded 4.

Outcome measures
The primary outcome was postoperative pain assessed using NRS scores. Secondary outcomes included time to first rescue analgesia, total postoperative fentanyl consumption, modified Aldrete score, and block-related complications.

Statistical analysis
Data were expressed as mean ± standard deviation and categorical variables as frequency and percentage. Student's t-test and Chi-square/Fisher's exact tests were used for analysis. A p-value <0.05 was considered statistically significant.

Ethical considerations
The study was approved by the Institutional Ethics Committee of BRD Medical College, Gorakhpur. Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study.

RESULTS
A total of 60 patients undergoing laparoscopic cholecystectomy were included in the study. The patients were equally divided into two groups, with 30 patients in Group A (ESPB) and 30 patients in Group B (EOIPB).

Table 1 shows the baseline demographic and anthropometric profile of the patients in both groups. Most patients in both groups belonged to the 18–30 years and 41–50 years age groups. The mean age in Group A was 44.4 ± 9.3 years, while in Group B it was 41.0 ± 8.5 years, and the difference was not statistically significant (p=0.155). Female patients were slightly higher in both groups, but gender distribution was comparable (p=0.602). Similarly, no significant difference was observed between the two groups with respect to height, weight, and BMI (p>0.05), indicating that both groups were comparable at baseline.

Table 2 depicts the distribution of patients according to ASA physical status. In Group A, 60.0% patients belonged to ASA Grade I and 40.0% to ASA Grade II, whereas in Group B, 73.3% patients were ASA Grade I and 26.7% were ASA Grade II. The difference between the two groups was not statistically significant (p=0.273).

Table 3 compares the postoperative analgesic outcomes between the two groups. Patients in Group A had significantly lower NRS pain scores at 0, 1, 6, and 12 hours after surgery compared to Group B (p≤0.001). However, at 18 and 24 hours, the difference in pain scores was not significant. The mean time to first rescue analgesia was significantly longer in Group A (108.0 ± 45.2 minutes) compared to Group B (80.0 ± 40.5 minutes) (p=0.014). Total fentanyl consumption during the postoperative period was also significantly lower in Group A than Group B (11.5 ± 23.4 mg vs 56.3 ± 74.7 mg; p=0.003), suggesting better postoperative analgesia with ESPB.

Table 4 shows the modified Aldrete scores at 24 hours postoperatively. Most patients in both groups had a score of 9. Although a greater number of patients in Group B achieved a score of 10, the overall difference in modified Aldrete scores between the groups was not statistically significant (p>0.05). The mean modified Aldrete score was comparable in both groups.

Table 5 presents the postoperative complications observed in the study. No patient in either group developed nausea, vomiting, hypotension, or dyspnea during the postoperative period. This indicates that both ESPB and EOIPB were safe procedures without any major complications.

Figure 1 shows the comparison of preoperative hemodynamic parameters between the two groups. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were similar in both groups before surgery, and no statistically significant difference was observed.

Figure 2 demonstrates the intraoperative heart rate changes in both groups. Heart rate remained lower in Group A during surgery, and the difference became statistically significant at 15, 30, and 60 minutes intraoperatively (p<0.05).

Figure 3 compares intraoperative systolic blood pressure between the groups. Although baseline values were similar, systolic blood pressure was significantly higher in Group B at 15, 30, and 60 minutes during surgery (p<0.05).

Figure 4 illustrates the comparison of intraoperative diastolic blood pressure between the groups. Group B showed higher diastolic blood pressure values during the intraoperative period, particularly at 15, 30, and 60 minutes, and the difference was statistically significant (p<0.05).

Figure 5 depicts the intraoperative mean arterial pressure changes in both groups. Mean arterial pressure remained lower and more stable in Group A compared to Group B, with statistically significant differences observed at 15, 30, and 60 minutes intraoperatively (p<0.05).

Figure 6 shows the comparison of intraoperative oxygen saturation between the groups. Oxygen saturation remained stable and comparable throughout the surgery in both groups, and no statistically significant difference was observed at any time interval.

DISCUSSION
Effective postoperative pain management after laparoscopic cholecystectomy continues to be an important aspect of perioperative care. Although laparoscopic surgery is associated with smaller incisions and faster recovery compared to open procedures, patients still experience significant postoperative pain due to pneumoperitoneum, stretching of the peritoneum, visceral manipulation, and port-site incisions. Inadequate pain control can delay ambulation, prolong hospital stay, and increase postoperative morbidity. Therefore, regional anaesthesia techniques are increasingly being incorporated into multimodal analgesia protocols to reduce opioid consumption and improve recovery outcomes.

In the present study, both groups were comparable with regard to baseline demographic and clinical characteristics. The mean age, gender distribution, BMI, and ASA grading did not differ significantly between the two groups (p>0.05). Female predominance was observed in both groups, which is expected because gallstone disease is more common among females. Similar findings were reported by Hashim RM et al.[4], who compared ultrasound-guided ESPB and EOIPB in laparoscopic cholecystectomy and found no significant difference between the groups in terms of age, gender, BMI, ASA classification, or duration of surgery. Samtani P et al.[12] and Korkusuz M et al.[13] also reported comparable demographic profiles between study groups receiving different regional analgesic techniques. Gupta A et al.[7] similarly demonstrated that demographic variables and operative duration were comparable between patients receiving bilateral DTAP block and ESP block.

Preoperative hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were similar in both groups in our study, indicating that the groups were hemodynamically comparable before surgery. However, during the intraoperative period, patients in the ESPB group demonstrated significantly lower heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure at 15, 30, and 60 minutes compared to the EOIPB group (p<0.05). Oxygen saturation remained stable and comparable in both groups throughout the surgery. These findings suggest better attenuation of intraoperative stress response and improved analgesia with ESPB.

Our findings are consistent with those reported by Forero M et al.[6], who demonstrated that ESPB provides effective analgesia because of extensive spread of local anaesthetic into the paravertebral space, leading to blockade of both dorsal and ventral rami. Tulgar S et al.[14] also observed lower intraoperative heart rate and mean arterial pressure in patients receiving ESP block. In contrast, Elsharkawy H et al.[15] suggested that more superficial fascial plane blocks such as EOIPB mainly provide somatic analgesia with limited visceral and sympathetic blockade. The improved intraoperative hemodynamic stability observed in the ESPB group in our study may therefore be attributed to wider dermatomal spread and additional visceral analgesic effect.

Postoperative pain scores assessed using the Numeric Rating Scale (NRS) were significantly lower in the ESPB group during the early postoperative period. Patients receiving ESPB had lower pain scores at 0, 1, 6, and 12 hours after surgery compared to those receiving EOIPB ($p<0.05$). However, at 18 and 24 hours, pain scores became comparable between the two groups. Importantly, pain scores in the EOIPB group exceeded 4 during the early postoperative period, indicating inadequate analgesia and increased requirement for rescue analgesics. These findings indicate that ESPB provides superior early postoperative analgesia.

Similar observations were reported by Sahu L et al.[1], who compared ESP block with oblique subcostal TAP block and found significantly lower postoperative pain scores in the ESP group during the first 24 hours. Ali M et al.[16] also reported lower postoperative NRS scores in patients receiving ESPB during the early postoperative period. Khalil MS et al.[17] demonstrated superior analgesic efficacy of ESPB compared to other abdominal wall blocks, while Singh S et al.[18] in a meta-analysis concluded that ESPB provides prolonged duration of analgesia and better postoperative pain control across various abdominal surgeries.

In the present study, the mean time to first rescue analgesia was significantly longer in the ESPB group compared to the EOIPB group (108.0 ± 45.2 minutes vs 80.0 ± 40.5 minutes; $p=0.014$). Additionally, total fentanyl consumption was significantly lower in the ESPB group ($p=0.003$). These findings indicate better opioid-sparing effects with ESPB. Similar results were reported by Mahipal M and Anupma A[19], who observed prolonged duration before rescue analgesia and reduced opioid consumption with ESPB. Engineer SR et al.[20] also reported delayed requirement for rescue analgesia and improved postoperative comfort in patients receiving ESPB. Reduced opioid requirement is clinically important because it decreases opioid-related adverse effects such as nausea, vomiting, sedation, and respiratory depression.

Modified Aldrete recovery scores at 24 hours were comparable between the two groups, and no statistically significant difference was observed. Most patients in both groups achieved satisfactory recovery scores. Similar findings were reported by Sethi D et al.[21] and Yang et al.[22], who concluded that although regional blocks improve postoperative analgesia, their impact on recovery scores may remain limited when standardized perioperative protocols are followed.

No postoperative complications such as nausea, vomiting, hypotension, dyspnea, local anaesthetic toxicity, or block-related adverse events were observed in either group in the present study. Similar findings were reported by Sahu L et al.[1] and Metias MFY et al.[23], who also observed minimal complication rates with both ESPB and EOIPB when performed under ultrasound guidance. This highlights the safety and feasibility of both techniques in routine clinical practice.

Overall, the findings of the present study suggest that ESPB provides superior early postoperative analgesia, better intraoperative hemodynamic stability, prolonged duration before rescue analgesia, and reduced postoperative opioid consumption compared to EOIPB in patients undergoing laparoscopic cholecystectomy.

CONCLUSION

Both erector spinae plane block (ESPB) and external oblique intercostal fascial plane block (EOIPB) were found to be safe and effective modalities for postoperative analgesia following laparoscopic cholecystectomy. However, ESPB provided superior early postoperative pain relief, prolonged duration before rescue analgesia, improved intraoperative hemodynamic stability, and significantly reduced postoperative fentanyl consumption compared to EOIPB. Although recovery profiles were comparable between the groups, the overall analgesic efficacy of ESPB was better. These findings support the use of ultrasound-guided ESPB as an effective component of multimodal analgesia and a preferred regional anaesthesia technique for patients undergoing laparoscopic cholecystectomy.

Tables

Table 1: Baseline Demographic and Anthropometric Characteristics of the Study Population

Variable		Group A (n=30)	Group B (n=30)	p-value
Age Group	18–30 years	9 (30.0%)	13 (43.3%)	0.438*
	31–40 years	4 (13.3%)	6 (20.0%)	
	41–50 years	9 (30.0%)	7 (23.3%)	
	51–65 years	8 (26.7%)	4 (13.3%)	
	Age (years) (Mean ± SD)	44.4 ± 9.3	41.0 ± 8.5	0.155#
Gender	Male	14 (46.7%)	12 (40.0%)	0.602*
	Female	16 (53.3%)	18 (60.0%)	
Anthropometry	Height (cm)	165.4 ± 7.5	166.3 ± 9.3	0.677#
	Weight (kg)	69.4 ± 7.4	66.9 ± 12.5	0.358#
	BMI (kg/m²)	25.47 ± 2.9	24.22 ± 4.0	0.181#

*Chi-square test; #Independent sample t-test

Table 2: Distribution of the studied patients based on ASA Grade in both groups

ASA Physical Grading	Group A (n=30)	Group B (n=30)	p-value
Grade I	18 (60.0%)	22 (73.3%)	0.273*
Grade II	12 (40.0%)	8 (26.7%)	

Table 3: Comparison of Postoperative Analgesic Outcomes Between Groups

Variable		Group A (n=30)	Group B (n=30)	p-value
Numeric Rating Scale (NRS)	0 hour	2.13 ± 1.0	4.22 ± 1.1	<0.001
	1 hour	2.97 ± 1.0	5.10 ± 1.5	<0.001
	6 hours	3.23 ± 1.2	5.62 ± 1.4	<0.001
	12 hours	3.27 ± 1.5	4.75 ± 1.4	0.001
	18 hours	2.46 ± 1.3	3.02 ± 1.2	0.082
	24 hours	1.37 ± 1.1	1.82 ± 1.1	0.650
Rescue analgesia profile	Time to first rescue analgesia (minutes)	108.0 ± 45.2	80.0 ± 40.5	0.014
	Total fentanyl consumption (mg)	11.5 ± 23.4	56.3 ± 74.7	0.003

#Independent sample t-test*

Table 4: Distribution of the studied patients based on Modified Aldrete score in both

Modified Aldrete Score (24 hours post op)	Group A (n=30)	Group B (n=30)	p-value
8	3 (10.0%)	0 (0.0%)	0.116*
9	19 (63.3%)	17 (56.7%)	
10	8 (26.7%)	13 (43.3%)	
Mean±SD	9.17±0.59	9.43±0.50	0.065#

* Chi Square test; #Indepndent Sample 't' test

Table 5: Distribution of the studied patients based on complications in both groups

Complications		Group A (n=30)	Group B (n=30)	p-value
Nausea	Yes	0 (0.0%)	0(0.0%)	NA
	No	30(100.0%)	30(100.0%)	
Vomiting	Yes	0 (0.0%)	0(0.0%)	NA
	No	30(100.0%)	30(100.0%)	

Hypotension	Yes	0 (0.0%)	0(0.0%)	NA
	No	30(100.0%)	30(100.0%)	
Dyspnea	Yes	0 (0.0%)	0(0.0%)	NA
	No	30(100.0%)	30(100.0%)	

Figures Legends

Figure 1: Comparison of preoperative hemodynamics in both groups
Figure 2: Comparison of intraoperative heart rate between groups
Figure 3: Comparison of intraoperative Systolic Blood Pressure between groups
Figure 4: Comparison of intraoperative Diastolic Blood Pressure between groups
Figure 5: Comparison of intraoperative Mean Arterial Pressure between groups
Figure 6: Comparison of intraoperative SpO2 (%) between groups

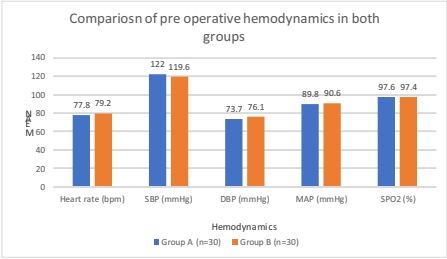

Figure 1

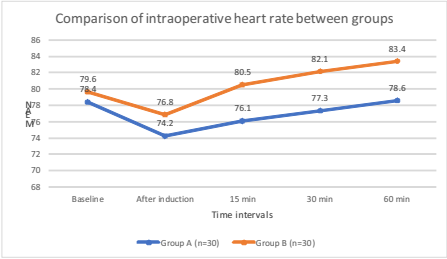

Figure 2

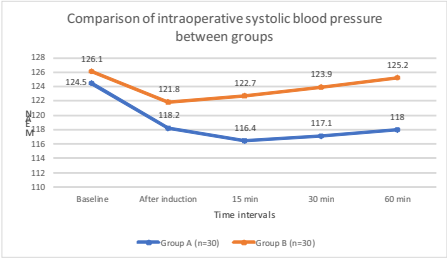

Figure 3

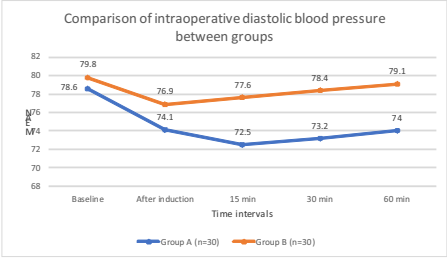

Figure 4

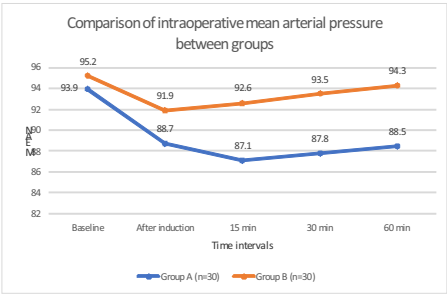

Figure 5

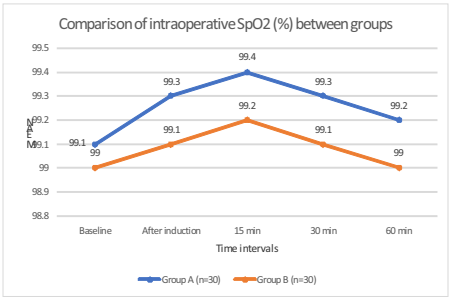

Figure 6

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