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ANALGESIC EFFICACY OF ULTRASOUND GUIDED RIGHT EXTERNAL OBLIQUE INTERCOSTAL PLANE BLOCK WITH POSTERIOR TRANSVERSUS ABDOMINIS PLANE BLOCK FOR LAPAROSCOPIC CHOLECYSTECTOMY. A RANDOMIZED CONTROLLED TRIAL.

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ABSTRACT **Background:** Postoperative pain management is essential after laparoscopic cholecystectomy (LC), a minimally invasive but often painful procedure. Traditional analgesics like NSAIDs and opioids carry side effects, prompting interest in ultrasound-guided truncal blocks as a safer, effective alternative. This study investigates the analgesic efficacy of a combination of right-sided external oblique intercostal plane block (EOIPB) and posterior transversus abdominis plane (TAP) block in reducing postoperative opioid requirement and better pain scores in patients undergoing laparoscopic cholecystectomy. **Methods:** In this randomized controlled trial, 80 patients undergoing elective LC were divided into two groups: Group A (control group) received standard general anaesthesia without regional blocks, while Group B (block group) received standard general anaesthesia along with right-sided EOIPB and posterior TAP block under ultrasound guidance. Postoperative opioid requirements, time to first rescue analgesia, numeric rating scale (NRS) scores at various intervals, and postoperative nausea and vomiting (PONV) incidence were assessed. **Results**: Group B demonstrated significantly lower number of patients requiring Inj. Tramadol in the first 12 and 24 hours ($p < 0.0001$), longer duration before first rescue analgesia (12.80 vs. 5.96 hours, $p<0.0001$), and lower NRS scores at all time intervals compared to Group A. Group B also had significantly lower rates of PONV ($p<0.05$). No complications were observed related to the blocks.**Conclusion:** Ultrasound-guided right EOIPB combined with right posterior TAP provides effective analgesia, reduces opioid requirement, and lowers PONV incidence in patients undergoing LC. This approach is safe, feasible in the supine position, and presents as a promising option for enhanced postoperative recovery following LC.

KEYWORDS : External Oblique Intercostal Plane Block, Transversus Abdominis Plane Block, Laparoscopic Cholecystectomy, Opioid Analgesics, Postoperative Pain, Ultrasonography.

INTRODUCTION

Cholelithiasis, a common gallstone disease, especially prevalent in northern India, often necessitates a Laparoscopic Cholecystectomy, which is considered the gold standard surgical procedure for its treatment[1]. Compared to the traditional open technique, laparoscopic surgery offers several advantages[2,3], including reduced bleeding, less postoperative pain, better respiratory function, and shorter hospital stays[4]. Despite these benefits, postoperative pain remains a significant issue, though less severe than with open surgery[5], and its management is a key concern in post-operative care.

Historically, pain has been managed using Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) and opioids. However, both of these drug classes were associated with well-known side effects, such as gastrointestinal issues and the risk of addiction or respiratory depression, respectively. In recent years, truncal blocks have gained popularity as an effective tool for managing postoperative pain in a multimodal analgesia approach. Ultrasound guidance has greatly enhanced the safety and precision of truncal blocks, making them a more reliable and effective option for pain control following laparoscopic procedures.

Truncal blocks like Erector Spinae Plane Block (ESPB)[9], Para Vertebral Block (PVB)[10], Quadratus Lumborum (QL) block[11], Serratus Anterior Plane Block[12], Lateral Transversus Abdominis plane (TAP) block[8,14,20], Subcostal Block[7], Modified BRILMA block[13] and External Oblique Intercostal Plane Block alone[15] or in combination, unilaterally or bilaterally, have been used as a part of multi modal analgesia to effectively manage the post operative pain following Laparoscopic Cholecystectomy (LC). The use of ultrasound has increased the precision and success rate of these blocks[18], although technical difficulties like positioning of the anaesthetised patient in ESPB, PVB and QL block, sparing of epigastric port site in Lateral TAP and umbilical port in subcostal TAP have still been a challenge. Multiple port site injection[7] has also been tried expecting co-operation of the surgical team for its performance and success.

External Oblique Intercostal Plane (EOIP)[25,26,27] block is performed under ultrasound guidance wherein local anaesthetic is deposited in between the external oblique muscle and intercostal muscle between the sixth and the seventh rib at the anterior axillary line. Twenty to thirty millilitres of local anaesthetic deposited in this fascial plane is proposed to spread and block both the anterior and lateral cutaneous nerves and provide effective analgesia from T6 to T9/T10 level.

In the Posterior TAP block[6], the local anaesthetic is administered under USG guidance between the tapering Transversus abdominis muscle and its aponeurosis and internal oblique muscle posterior to the mid axillary line offering adequate analgesia from T9 to T 12 dermatome levels.

We hypothesised that, considering the surgical technique of standard 4 port laparoscopic cholecystectomy, combination of right sided EOIP plane block and right sided lateral TAP would provide effective analgesia for the surgery. The primary objective of our study was to assess opioid (tramadol) requirement in the first 12 hours and 24 hours postoperatively and secondary objective was to evaluate the time of first rescue analgesia and the NRS score at rest at 0, 4, 6, 12- and 24-hours post-surgery and document post operative nausea vomiting and any procedure related post-operative complications.

STUDY DESIGN

This is a prospective, randomized controlled trial done after the approval from the Ethics Committee of Yashoda hospital and research centre, on eighty patients undergoing elective Laparoscopic Cholecystectomy, with the undermentioned inclusion and exclusion criteria. The study was carried out in accordance with the Declaration of Helsinki, 2013 and Good Clinical Practice.

INCLUSION CRITERIA

ASA Grade I & II.
Age between 18-65 yrs.
Elective cases.
BMI less than 30 kg/m2.

EXCLUSION CRITERIA

Refusal to participate in the study.
Any known Allergy to the local anaesthetic drug
Chronic pain conditions
Pregnant patient
Prior abdominal surgery
Allergy/infection at the site of block
Blood coagulation disorder

A detailed Pre anaesthetic check-up was done, patients were explained the study design and Numeric pain rating scale (NRS), and a written informed consent was obtained from each patient who fulfilled the above inclusion/ exclusion criteria. They were randomly assigned to one of the groups using block randomization in blocks of 4. A computer-generated randomization list was employed to ensure balanced group assignments across the 80 participants.

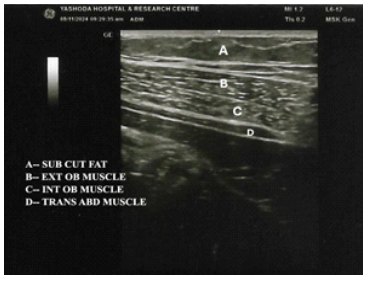
GROUPA: In which no regional blocks were administered**.**

GROUP B (BLOCK): In which USG guided Right EOIP block + Right posterior TAP block was administered.

The patient's vital signs were recorded, and a peripheral venous access was secured. Antibiotics were administered, followed by I.V. Inj. Ondansetron 4 mg and I.V.Inj. Pantoprazole 40 mg in the preoperative area. The patient was then shifted to the operating room, where standard monitoring was initiated, and pre-induction vital signs were documented. After pre-medication with Inj. midazolam 0.03 mg/kg BW IV and Inj. Glycopyrrolate 0.2mg IV, the patients received Inj. Fentanyl 2mcg/kg BW. They were induced with Inj. Propofol 2mg/kg BW and Inj. Atracurium 0.5mg/kg BW, and ventilated on mask for three minutes with 100% oxygen and the airway was then secured with appropriate size I-Gel. General anaesthesia was maintained on inhalational Sevoflurane in an admixture of O_2 and N_2O (40:60) keeping a MAC of 1.0. The ventilation was set to maintain the $EtCO_2$ between 35-45 mmHg.

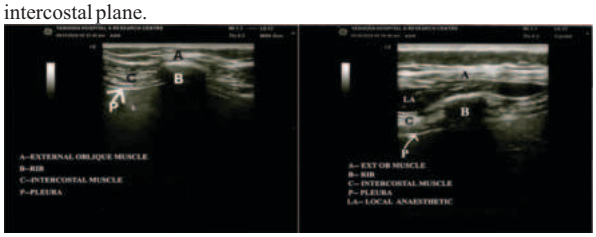
GROUPA After the induction of GA, no block was administered in this group.

GROUP -B After the induction of GA, under all aseptic precautions and USG Guidance, patients were administered right sided posterior TAP and right External oblique intercostal plane block between the 6th and 7th intercostal space in supine position, using a high frequency (6-12 Hz) Linear probe (GE- Versana active 1.5 serial no.- 6242139WXO), using 20 ml of 0.25% Bupivacaine (Plain) for each block.



For the posterior TAP block, USG probe was kept at the level mid-axillary line between costal margin and the iliac crest with the aspect marker facing anteriorly. The three abdominal muscles viz the External Oblique (EO), the Internal Oblique (IO) and the Transversus Abdominis (TA) muscle, were identified. The probe was slided posteriorly to visualise the tapering end of TA muscle and its aponeurosis. A 23G needle was then advance in plane and after negative aspiration 20 ml of 0.25% Bupivacaine was administered between fascial plane of IO and TA muscle.

For Right External Oblique Intercostal Block, linear transducer was positioned perpendicular to the 6th rib, between the anterior axillary and mid clavicular line. The 6th-7th intercostal spaces was visualized, identifying the ribs, external oblique muscle, and underlying pleura. A 23 G hypodermic needle was advanced in plane and 0.25% 20 ml Bupivacaine was then injected between the External Oblique intercostal plane.



The Block was performed by the same anaesthesiologist in all the patients.

The patients in both the groups further received Inj. Paracetamol 1gm I.V. along with Inj. Magnesium sulphate 1gm I.V. and Inj. Dexamethasone 8 mg I.V. before the incision.

Standard monitoring was initiated, including Non-Invasive Blood Pressure (NIBP), Electrocardiogram (ECG), Pulse Oximetry (SpO2), Heart Rate (HR), End-Tidal CO2 (EtCO2) and the Temperature.

Surgery was then performed with a standard 4 port surgical technique in which two 10 mm trocars were inserted in the peri umbilical and the epigastric region, and two 5 mm ports were inserted in mid clavicular and Subcostal region on the right side. Pneumoperitoneum was created with dehumidified CO2 initially at the flow of 1-2 Litres/minute and the final intra-abdominal pressure of 12mmHg was maintained with the gas flow at 6 Litres/minute.

Vitals were recorded every 10 minutes intraoperatively. A rise in mean arterial pressure (MAP) above 90 mmHg or HR of more than 20% of the baseline value was first treated by increasing the depth of anaesthesia by increasing the inhaled concentration of Sevoflurane. Refractory Hypertension or increase in heart rate which was not responsive to increase in depth of anaesthesia was treated using Inj. Esmolol 10 mg IV bolus. Similarly, Hypotension (defined as a fall in MAP below 60 mmHg) was managed using Inj. Phenylephrine 50mcg I.V. bolus.

All patients received normal saline as maintenance fluid intra-operatively.

At the end of surgery, the residual effect of NMBA was reversed using Inj. Neostigmine 2.5mg IV and Inj. Glycopyrrolate 0.5 mg IV. The I-Gel was removed following through oropharyngeal suction and return of spontaneous ventilation.

The patient was then shifted to Post Anaesthesia Care Unit (PACU) with Oxygen via face mask and kept for observation. Vitals were recorded every 15 minutes for the first hour and then one hourly thereafter till the discharge from the PACU. The NRS at rest was assessed at zero min, 4 hour, 6hour, 12hour, 24 hour post operatively. The patient was discharged from PACU, when the modified Aldrete's score >9.

All patients who underwent surgery were given Inj. Paracetamol 1 gm I.V. three times a day at equal intervals, the first dose being administered immediately after induction of anaesthesia. Inj. Diclofenac75mg I.V, as infusion in 100 ml normal saline, was given one hour post operatively. For any further complain of pain in between or at the time of assessment of NRS, if the NRS score was > 4, Inj. Tramadol 50 mg was given and NRS at rest was assessed 30 mins following the injection. In NRS, an assessment score of '0' meant no pain and a score of '10' indicates the worse possible pain. The person who assessed the NRS in the post operative recovery and thereafter were blinded for the group to which the patient belonged.

The secondary outcome of the study for PONV was assessed on verbal descriptive score from 0-4, wherein '0' was no nausea, '1' mild nausea, '2' moderate nausea, '3' vomiting once, '4' multiple vomiting episodes. Patients who had a score of >2 were given Inj. Ondansetron 4 mg IV.

The sample size was based on the study by Suseela et al which

compared the analgesic efficacy of subcostal TAP vs port site infiltration with local anaesthetic in terms of tramadol consumption in the first 24 hours.

Allowing for 10% attrition and assuming 80% Power and 95% Confidence interval, the minimum calculated sample size for each arm was 40 (total = 80).

STATISTICALANALYSIS

Data is coded and recorded in MS Excel spreadsheet program. SPSS v23 (IBM Corp.) will be used for data analysis.

Descriptive statistics was elaborated in the form of means/standard deviations and medians/IQRs for continuous variables, and frequencies and percentages for categorical variables. Group comparisons for continuously distributed data was made using independent sample 't' test when comparing two groups. Chi-squared test was used for group comparisons for categorical data. In case the expected frequency in the contingency tables will be found to be <5 for >25% of the cells, Fisher's Exact test will be used instead. Linear correlation between two continuous variables will be explored using Pearson's correlation (if the data will be normally distributed) and Spearman's correlation (for non-normally distributed data). Statistical significance will be kept at $p < 0.05$.

OBSERVATIONS

Eighty patients meeting the selection criteria were randomly assigned to either Group A or Group B and received anaesthesia according to the established protocol. Demographic characteristics, such as age, sex, ASA classification, and BMI, were comparable between the two groups ($p > 0.05$), as summarized in Table 1.

DEMOGRAPHIC VARIABLES (Table 1)

PARAMETERS	GROUP A	GROUP B	P VALUE
AGE (YEARS)	42.10+/-12.106	44.65 +/- 13.431	0.375
SEX (M/F)	11(27.5%)/29 (72.5%)	10(25%)/30(75%)	0.799
ASA (I/II) (n/%)	29 (72.5)/11 (27.5)	24(60.0)/ 16 (40.0)	0.237
BMI (Kg/m2)	23.9903 +/- 1.921	24.052 +/- 1.897	0.884

ANALGESIC EFFICACY COMPARISON

The comparison of analgesic efficacy between the groups is shown in Tables 2 and 3. Significantly fewer patients in Group B required tramadol in the first 12- and 24-hours post-surgery than in Group A ($p < 0.0001$). Furthermore, the time until the first demand for rescue analgesia (FRA) was significantly longer in Group B than in Group A.

TRAMADOL CONSUMPTION (TABLE 2)

PARAMETER	GROUP A		GROUP B		
NU. OF PATIENTS REQUIRING TRAMADOL	N	%	N	%	P VALUE
First 12 hrs	40	100	8	20	< 0.0001
24 hrs	40	100	25	62.5	< 0.0001

COMPARISION OF THE ANALGESIC DATA (Table 3)

PARAMETERS	GROUP A	GROUP B	P VALUE
TOTAL NU. OF PATIENTS REQUIRING TRAMADAOL IN 24 HRS	40 (100%)	25 (62.5%)	< 0.0001
TIME OF FRA	5.961 +/- 1.95	12.809 +/- 3.07	< 0.0001

The Numeric Rating Scale (NRS) pain scores in Group B were significantly lower than in Group A at various time points: immediately post-op (0 hrs, $p < 0.0001$), 4 hrs post-op ($p < 0.0001$), 6 hrs post-op ($p < 0.0001$), and 12 hrs post-op ($p < 0.0095$). However, there was no significant difference in pain scores between the groups at 24 hrs post-op ($p = 0.4751$).

The Numeric Rating Scale (NRS) (Table 4)

	GROUP A	GROUP B	P VALUE
NRS 0	2.08 +/- 0.723	0.275+/- 0.452	< 0.0001
NRS 4	2.80 +/- 0.723	0.55 +/- 0.6774	< 0.0001
NRS 6	2.15+/- 0.834	1.30+/- 0.6076	< 0.0001
NRS 12	2.10+/- 0.900	1.60+/- 0.7779	0.0095
NRS 24	0.78+/-0.480	0.70+/- 0.5164	0.4751

The incidence of Postoperative Nausea and Vomiting (PONV) was higher in Group A compared to Group B, with a statistically significant difference in PONV scores ($p = 0.024$). Table 5.

No procedure-related complications were observed in Group B.

INCIDENCE OF PONV (TABLE 5)

	GROUP A	GROUP B	P VALUE
PONV SCORE	0.90+/- 1.194	0.42+/- 0.501	0.024

DISCUSSION

Laparoscopic cholecystectomy (LC) is the standard treatment for gallstone disease, but it is often associated with moderate post-operative pain. This pain is primarily due to port site incisions, the effects of pneumoperitoneum, and the gallbladder fossa wound, with skin incisions accounting for 50-70% of the discomfort[29]. The conventional 4-port LC technique is frequently complemented by multimodal analgesia, including regional anaesthesia, to reduce dependence on systemic drugs and minimize side effects.

Our study demonstrated that the combination of right-sided lateral transversus abdominis plane (TAP) block and right-sided external oblique intercostal plane (EOIP) block effectively decreased the need for tramadol, improved pain scores, and reduced the incidence of post-operative nausea and vomiting (PONV) in patients undergoing conventional 4-port LC.

Hamilton and Manickam[25](2018) suggested that local anaesthetic administration in the thoracic fascial plane blocks the lateral cutaneous branches of the T7-T11 spinal nerves. Later, Hamilton et al. further investigated drug diffusion after the external oblique fascial plane block in a cadaver study using dyes, which supported this hypothesis. Elsharkawy et al.[26](2021) presented EOIP block as an effective technique for analgesia of the upper midline and lateral abdominal wall, providing a dermatomal sensory block at the T6-T10 level in the anterior axillary region and the T6-T9 level in the midline.

El-Dawlatly et al.[14] (2009) were the first to describe the ultrasonographic technique for TAP block, using an in-plane approach with the probe positioned between the 12th rib and the iliac crest. They found a significant reduction in the demand for systemic analgesics compared to standard general anaesthesia. Ozciftci and Serhat[8] (2022) compared unilateral and bilateral TAP blocks for LC, finding that a unilateral TAP block provided similar post-operative analgesia to a bilateral TAP block, while also reducing post-operative opioid consumption and rates of nausea and vomiting.

Tsai and Hsiao-Chien et a[l6].in 2017 in the updated review of anatomy and technique of TAP block describing that posterior TAP approach successfully covers the dermatomes from T9-T12 level, wherein the local anaesthetic was injected above the tapering Transversus abdominis muscle and its aponeurosis, similar to the approach we decided to follow.

In our study of 80 patients, 40 in Group A received conventional general anaesthesia followed by an injection of diclofenac (75 mg) one hour post-operatively, with paracetamol administered at regular intervals. In contrast, Group B received a combination of posterior TAP and EOIP blocks in addition to the standard regimen. Both groups were comparable in terms of age, sex, ASA physical status, and BMI. None of the patients in Group B required additional doses of tramadol in the first six hours after surgery, whereas 26 of the 40 patients in Group A required tramadol. Within the first 12 hours post-operatively, all 40 patients in Group A required rescue analgesia, while only eight patients in Group B needed tramadol. Over the first 24 hours, 25 patients in Group B required tramadol compared to all patients in Group A, with these differences also being statistically significant ($P < 0.0001$). The difference in the numeric rating scale (NRS) pain scores in the immediate post-operative period was statistically significant ($P < 0.0001$).

Truncal blocks, such as TAP and EOIP blocks[30], effectively target somatic pain from incisions. While they are less effective for visceral pain, other options like epidural, ESPB or Paravertebral block could be considered, though these require positioning the patient laterally. TAP and EOIP blocks can be administered with the patient supine, making them more convenient. In this study, the blocks in Group B were administered pre-emptively, before skin incision, which likely prevented central sensitization by blocking nociceptive stimuli[28], contributing to lower pain scores and tramadol requirements.

All patients received 8 mg IV dexamethasone, which has anti-inflammatory properties and reduces PONV following general anaesthesia. Hussain et al.[35](systematic review and meta-analysis) demonstrated dexamethasone's effective analgesic efficacy as both a perineural and systemic adjuvant [34,36,37].

The time to first rescue analgesic was significantly longer in Group B (12.8 ± 3.07 hours) compared to Group A (5.96 ± 1.95 hours). NRS scores were better across all time points (0, 4, 6, 12, and 24 hours) for Group B, with statistically significant differences at 0, 4, 6, and 12 hours.

Complications associated with truncal blocks[38], such as vascular injury, hematoma formation, and local anaesthetic toxicity, were not observed in this study. Additionally, underlying visceral injury and pneumothorax may occur with truncal blocks; however, the use of ultrasound-guided, in-plane block techniques minimizes these risks. As superficial plane blocks, they are safer and more suitable for patients on anticoagulants[39] since these areas are not highly vascular and can be compressed if needed.

PONV incidence was higher in Group A, likely due to greater opioid use, despite both groups receiving antiemetics. Opioids such as tramadol have a dose-dependent relationship with PONV, explaining the increased rates in Group A. The statistically significant difference in PONV between the two groups highlights the potential benefit of reducing opioid use in LC procedures.

CONCLUSION

The study results showed that patients who underwent ultrasound-guided right EOIPB along with right sided posterior TAP following the induction of general anaesthesia for postoperative analgesia in LC had lower tramadol consumption in the postoperative period and a better NRS at all measurement times compared to the control group with practically no complication associated with the procedure. The incidence of PONV is also less and patients had a longer pain free period (first rescue analgesic demand) postoperatively. This combination of EOIPB and Posterior TAP Block can be recommended as an effective modality for post operative pain management in patient undergoing LC.

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