

## Laparoscopic Cholecystectomy - Comparison of two different techniques of ultrasound guided blocks for postoperative pain relief

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### Abstract

**Background :** Laparoscopic cholecystectomy (LC) can induce moderate postoperative pain due to small keyholes on the abdominal wall. The oblique subcostal transversus abdominis plane block (OSTAP) has been used for postoperative pain management after LC but found ineffective. **Objective:** Our aim is to compare the efficacy of erector spinae block with OSTAP block for postoperative pain management after LC. **Material & Methods:** Ninety patients, posted for LC were divided into three equal groups of 30 each. Erector spinae plane block was given in the ESP group. Oblique subcostal transversus abdominis plane block was given in the OSTAP group and IV analgesics were administered in control group for postoperative pain management. Postoperative rescue analgesic (paracetamol) consumption, time to 1<sup>st</sup> rescue analgesia request, numerical rating score (NRS), and any complications in 1<sup>st</sup> 24 hrs between the three groups were recorded and analyzed. Statistical Package for the Social Sciences version 21.0 was applied for statistical analysis. Descriptive statistics were expressed as mean  $\pm$  standard deviation. **Result:** Postoperative rescue analgesia (paracetamol) consumption was  $2.1 \pm 0.76$  gm in ESP group,  $2.90 \pm 0.18$  gm in OSTAP group and  $4.16 \pm 0.65$  gm in control group which was statistically significant. Time to 1<sup>st</sup> rescue analgesia request was  $374.15 \pm 30.55$  mins in ESP group,  $294.61 \pm 43.18$  mins in OSTAP group and  $152 \pm 37.44$  mins in control group which was statistically significant. **Conclusion:** Ultrasound guided ESP block is more effective in postoperative pain management after LC when compared to OSTAP group and control group. **Keywords:** Cholecystectomy, laparoscopy, postoperative pain management, erector spinae plane block, oblique subcostal transversus abdominis plane block

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### Introduction

Laparoscopic cholecystectomy (LC) is one of the most common minimally invasive surgery performed through small keyholes on abdominal wall. LC can cause moderate to severe postoperative pain which have several components like incisional pain from the trocar site (somatic pain) and deep abdominal pain (visceral pain). [1] Multimodal approaches including opioids, nonsteroidal anti-inflammatory drugs, dexamethasone, gabapentinoids, local anesthetic infiltration to port sites, epidural analgesia and transversus abdominis plane block (TAP) have been used to alleviate postoperative pain after LC. [2] Hebbard et al [3] first described the subcostal approach of TAP block for postoperative pain management in upper abdominal surgeries. Few studies have reported that ultrasound guided oblique subcostal transversus abdominis plane (OSTAP) blocks reduced postoperative pain scores and opioid consumption in the first 24 hrs after LC but it is not effective in relieving visceral pain. Forero et al [4] first described the ultrasound guided ESP block which target the ventral rami, dorsal rami, and rami communicantes of the spinal nerves, so it is more effective against both somatic and visceral pain. Also, spread of local anaesthetic agent extends both cranially and caudally over several dermatomal levels producing better analgesia. Few studies have found that ESP block can provide postoperative

analgesia after different abdominal surgeries. [5] The present study was done to evaluate the analgesic efficacy of ultrasound guided ESP block and OSTAP block after laparoscopic cholecystectomy. Our primary aim was to compare the total rescue analgesia consumption at the postoperative 24th hour between the three groups. The secondary aims were time of 1<sup>st</sup> rescue analgesia request, NRS score at different time points, and any complications in 1<sup>st</sup> 24 hrs.

### Material & Methods

This is a prospective, randomized controlled study conducted at a tertiary care hospital in Odisha after approval of institutional ethical committee between September 2018 and October 2020. All patients involved had given written informed consent for inclusion into this study. Patients aged 20-60 years with an American Society of Anaesthesiologists (ASA) physical status classes of I and II who were scheduled to undergo elective LC were included in this study.

### Exclusion criteria

- Patients who refused enrolment
- Known allergy to local anesthetic
- Those with bleeding diathesis
- BMI > 30 kg/m<sup>2</sup>
- Infection at the site of needle puncture

The patients were divided into three groups, two groups received either ultrasound guided ESP block or OSTAP block and third group or control group received our institute's standard analgesia plan with no block. Randomization was performed according to a computer-generated sequence of random number and allocation allotments were stored in sealed opaque envelopes to be opened prior to block

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procedures. Standard monitoring procedures included pulse oximetry, electrocardiography, bispectral index and noninvasive arterial pressure. Ringers' lactate (15ml/kg) was started after putting a 20 G iv cannula. All patients were premedicated with intravenous (i.v.) midazolam 0.04 mg/kg and fentanyl 2mcg/kg. USG guided blocks were performed. For all blocks, a GE Logiq F™ (General Electric Healthcare, Little Chalfont, United Kingdom) ultrasound with a high frequency (6–15 MHz) 38mm L6–12 linear probe and a Stimplex® A 50 mm (B Braun HNS 11-12218, Stockert GmbH, Botzinger Strabe 72, D-79111 Freiburg, Germany) were used. LA mixture included 20 ml of bupivacaine 0.375%, was injected on each side. Induction was performed using propofol 2–3 mg/kg and vecuronium bromide 0.01 mg/kg and maintained with 0.6 minimum alveolar concentration sevoflurane with target BIS 40-60. Pneumoperitoneum was evacuated in all patients at the end of surgery. Then patients were extubated and transferred to the post anesthesia care unit (PACU). Follow up in PACU was performed by anesthesiologist who were blinded to the groups.

**Erector spinae plane block**

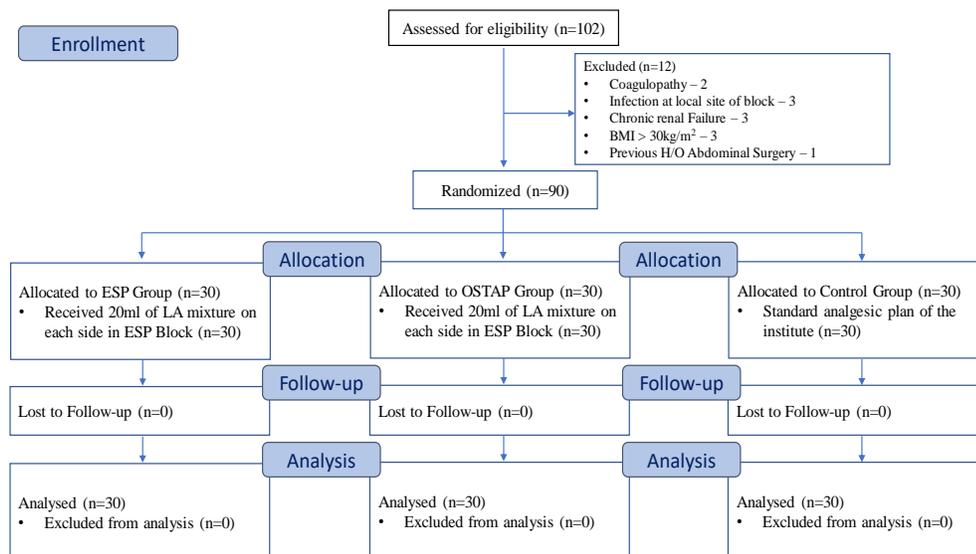
ESP block was given in left lateral position in the out of plane approach using a high frequency linear transducer. The transducer was put longitudinally 2.5–3 cm lateral to the T9 spinous process. The tip of the T9 transverse processes was located and superficial to it the erector spinae muscles were identified. A 21G 10cm needle (B. Braun) was inserted into the fascial plane on the anterior aspect of the erector spinae muscle. The position needle tip was confirmed by visible fluid spread lifting the erector spinae muscle off the bony shadow of the transverse process of T9 and 20 mL of bupivacaine 0.375% was injected. Due to reports that ESP blocks visceral pain and as at least one trocar is placed in the midline, the same procedure was repeated for the opposite side.

**Oblique subcostal transversus abdominis plane block**

OSTAP block was performed in the supine position with the in plane approach using a high frequency linear transducer. The transducer was put immediately below the costal margin obliquely and rectus abdominis, transverse abdominis, internal oblique and external oblique muscles were identified. A 21G 10cm needle (B. Braun) was inserted using an inplane approach from medially to

laterally and 20 ml of bupivacaine 0.375% was injected between the fascia immediately above the rectus abdominis muscle. Postoperative pain was assessed using the numerical rating score (NRS). The NRS is a segmented numeric version of the Visual Analog Scale (VAS) in which a respondent selects a whole number (0–10) that best reflects the intensity of his/her pain. The 11-point numeric rating scale ranges from 0 representing no pain to 10 representing extreme pain. Changes in NRS at rest and on movement were recorded at different time intervals. During the 1<sup>st</sup> 24 hr postoperative period, Paracetamol 1gm was given if Numeric Rating Scale score (NRS) > 4. Total consumption of paracetamol in 1<sup>st</sup> 24 hrs and time to 1<sup>st</sup> rescue analgesia was measured in all groups. NRS pain scores was recorded postoperatively at the 20<sup>th</sup> min, 40<sup>th</sup> min, 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup>, 12<sup>th</sup>, 15<sup>th</sup>, 18<sup>th</sup>, 21<sup>st</sup> and 24<sup>th</sup> hr both at rest and when coughing. Shoulder pain during the first 24 hr and presence of postoperative nausea and vomiting were noted. Postoperative nausea was assessed by patients on a 4 point scale (0- none, 1- mild, 2- moderate, and 3- severe). Sample size was calculated based on a pilot study with 10 patients in each group. 20% reduction in consumption of rescue analgesia in postoperative 24 hr was considered to be clinically significant. The mean paracetamol consumption in ESP block group was 1.7 ± 0.23 gm, in OSTAP block group was 2.65 ± 0.12 gm and in control group it was 3.9 ± 0.94 gm. Using power of 0.90 and significance level of 0.05 minimum sample size was calculated to be 26 patients for each group. Considering the possibility of dropouts, we decided to include 30 patients for each group. Statistical Package for the Social Sciences version 16.0 statistical package program (SPSS Inc., Chicago, IL, USA) was applied for statistical analysis. Descriptive statistics were expressed as mean ± standard deviation. For univariate analysis of means between the groups a 2 sample, independent t-test assuming equal variances were used. For data without normal distribution, Mann–Whitney U test was used. Ratios were compared using Chi-square test and Categorical variables were compared using Fisher's exact test. Continuous variable was tested for normality via the Shapiro–Wilk test. P values < 0.05 was considered statistically significant.

**Results**



**Fig 1: Flow chart**

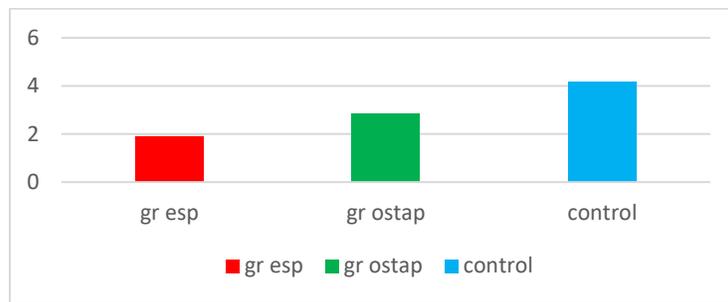
Hundred and two patients scheduled to undergo LC were evaluated for inclusion in this study. Two patients for coagulopathy, three for infection at block site, three for chronic renal failure, three for

BMI>30kg/m<sup>2</sup> and one patient with history of abdominal surgery were excluded from the study. 90 patients were included in the study and all completed the study.

**Table 1: Descriptive variables of groups.**

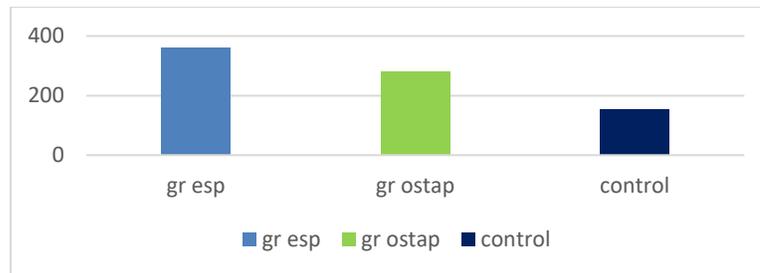
| Variables                    | Group ESP (n=30) | Group OSTAP (n=30) | Group Control (n=30) | P value (esp vs ostap) | P value |
|------------------------------|------------------|--------------------|----------------------|------------------------|---------|
| Age(years)                   | 51.39±12.16      | 53.11±12.82        | 52.34±12.33          | 0.765                  | 0.543   |
| Female                       | 20               | 18                 | 19                   | 0.711                  | 0.518   |
| Male                         | 10               | 12                 | 11                   |                        |         |
| ASA I                        | 18               | 15                 | 17                   | 0.509                  | 0.654   |
| ASA II                       | 12               | 15                 | 13                   |                        |         |
| Surgical Time (mins)         | 49.18±9.33       | 54.26±8.44         | 50.28±7.95           | 0.534                  | 0.157   |
| Block Performing Time (mins) | 9.34±1.88        | 9.85±1.25          | NIL                  | 0.154                  | 0.421   |
| BMI (kg/m <sup>2</sup> )     | 25.22±5.16       | 26.15±5.19         | 27.12±5.28           | 0.135                  | 0.253   |

There was no statistically significant difference between the three groups regarding the descriptive variables.(table 1)The p value between ESP and OSTAP groups have been calculated using unpaired t test and between all the three groups have been calculated using ANOVA test



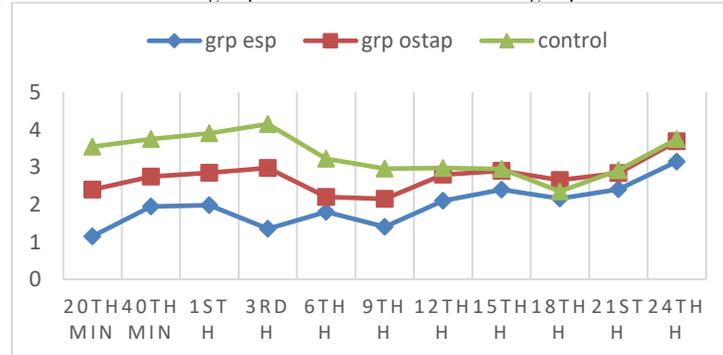
**Fig 2: Total analgesic consumption in 24 hrs**

Figure 2 shows total analgesic consumption(paracetamol in gm) in all the three groups. Postoperative rescue analgesia (paracetamol) consumption was 2.1± 0.76gm in ESP group, 2.90 ±0.18gm in OSTAP group and 4.16± 0.65gm in control group which was statistically significant.



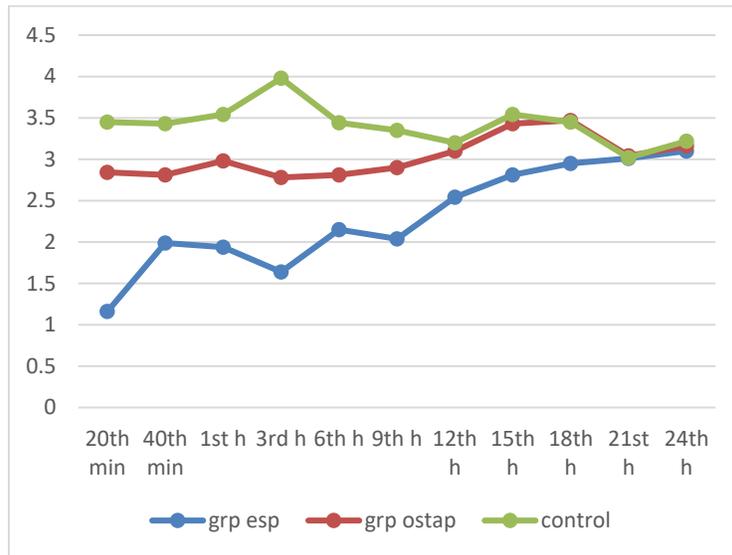
**Fig 3: Time to first analgesia request**

Figure 3 shows time to first rescue analgesia (mins) in all the three groups. Time to 1<sup>st</sup> rescue analgesia request was 374.15±30.55 mins in ESP group, 294.61±43.18 mins in OSTAP group and 152± 37.44mins in control group which was statistically significant.



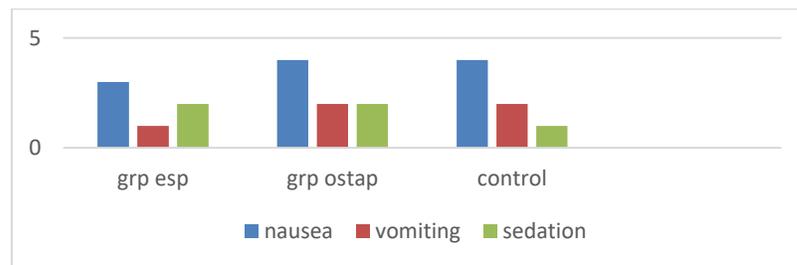
**Fig 4: Evaluation of Numeric Rating Scale scores at rest**

Figure 4 shows numeric rating scale (NRS) at rest in all the three groups. In 1<sup>st</sup> 6hrs NRS score at rest was lower in ESP group than OSTAP group which was statistically significant (p<0.05). After 6 hrs NRS score was comparable in both block groups. On the other hand NRS score was higher than both block groups in the control group and was comparable after 6 hrs.



**Fig 5: Evaluation of Numeric Rating Scale scores during coughing/movement**

Figure 5 shows numeric rating scale (NRS) on coughing / movement in all the three groups. In 1<sup>st</sup> 6hrs NRS score on coughing/movement was lower in ESP group than OSTAP group which was statistically significant (p<0.05). After 6 hrs NRS score was comparable in both block groups. On the other hand NRS score was higher than both block groups in the control group and was comparable after 9 hrs.



**Fig 6: Incidence of PONV and sedation**

Figure 6 shows different complications (nausea, vomiting, sedation) between all the three groups. No patient had right shoulder pain in either study group. There was no statistical difference (p > 0.05) in complications in all groups. 4 patients in ESP group and 6 patients in OSTAP group had nausea and vomiting which was not statistically significant. 2 patients in group esp and group ostap developed sedation whereas 1 patient in control group developed sedation.

**Discussion**

In our study, rescue analgesic (Paracetamol) consumption was significantly lower in the ESP group at 24 hr postoperatively compared to OSTAP and control group. Time to 1<sup>st</sup> rescue analgesia was increased in ESP group compared to OSTAP group and control group which was statistically significant. NRS scores at rest and after coughing were significantly less in the ESP group compared to OSTAP and control group. The control group showed a significantly higher analgesic requirement and higher NRS scores both at rest and with coughing with a lesser time to 1<sup>st</sup> rescue analgesia when compared to both block groups. There was no significant difference between the groups in postoperative complications. Acute pain following LC has several components like incisional pain from the trocar site, local visceral pain, parietal pain, and referred shoulder pain. Bisgaard et al [5] reported that parietal pain due to a skin incision contributed more to postoperative pain than other

components. Recent studies evaluated the effect of OSTAP block for post-operative analgesia after LC. Studies have reported that OSTAP block produced analgesia for somatic pain and parietal pain of almost the entire anterior abdomen and effectively reduced postoperative pain. Oksar et al.[6] studied the effects of intercostal-iliac TAP block, OSTAP block, and intravenous multimodal analgesia after LC. They found that OSTAP block was highly efficient in reducing postoperative pain scores compared to other methods. Basaran et al [7] reported that OSTAP block successfully decreased postoperative pain after LC. Ramkiran et al [8] compared the effectiveness of a rectus sheath block-OSTAP block combination, OSTAP block alone, and conventional port site infiltration for postoperative pain. They reported that in the combination group, pain scores were significantly low at the second postoperative hour. Also, opioid consumption in the postoperative 24 h was significantly low in the combination group. In spite of successful outcomes of many studies, the patchy pattern of sensory block over the lateral and posterior abdominal walls may induce discomfort with OSTAP block after LC.

Although OSTAP block have effect on somatic and parietal components of postoperative pain after LC, it has no effect on visceral component, so it may cause inadequate analgesia in some patients. Thus, multimodal analgesic technique with an alternative approach to alleviate postoperative visceral pain after LC

may be required. Ultrasound guided ESP block can produce blockage of both visceral and somatic nerve fibers making it excellent choice for postoperative analgesia.[9]ESP block can block the rami communicantes that transmit fibers to and from the sympathetic ganglia. Few studies are there in literature which shows the efficacy of ESP block for postoperative pain management after LC.[10,11] Tulgar et al [12] described multimodal analgesia protocols in three patients who had endoscopic retrograde cholangiopancreatography, followed by LC. They performed ultrasound guided ESP block at the level of T8 with 10 ml of 0.5% bupivacaine, 5 ml of 2% Lidocaine and 5 ml of isotonic saline following anesthesia induction. They reported that in an ambulatory surgical setting, the NRS scores of the patients were under 3/10. Tulgar et al. [13] assessed the effect of ultrasound guided ESP block on postoperative pain scores and analgesic consumption after LC. In their study, they increased the bupivacaine concentration to 0.375% due to block failure and insufficient sensorial block. Aksu et al [14] described the cases of three pediatric patients who received ESP block for pain management after LC. They performed ESP blocks at the level of T7 with 0.5 ml/kg of 0.25% bupivacaine and found that none of the patients required rescue analgesia in the first postoperative 48 hours. They concluded that bilateral ESP block provides effective analgesia in pediatric LC.

Altıparmak et al [15] concluded that ESP block reduced the postoperative opioid consumption, pain scores, and intra operative fentanyl requirement more effectively than OSTAP block after LC. The ideal concentration of local anesthesia for ESP block in thoracic and abdominal surgeries was yet to be determined. In a study by Kashani et al [16] 3.6 ml of local anesthetic per vertebral level was reported to be adequate in ESP block.

However, spread of local anesthesia at different thoracic or lumbar vertebral levels may differ. So local anesthesia volume and concentration may vary according to patients' age and type of surgery to be performed. Few studies have reported that, 20 ml of local anesthesia applied at T4 has been shown to spread caudal and cephalad for three to seven vertebral levels.[17,18] Though ideal concentration of local anesthetic for ESP block has yet to be decided, we in our study used 20 mL 0.375% bupivacaine.

Vidal et al[19] in a cadaveric study concluded that ESP block produced epidural, neural foramina, and intercostal spread of local anesthetic. This extensive spread of local anesthetic agent may be more over a larger dermatomal area than the OSTAP block. So ultrasound guided ESP block can be performed simply and quickly with easily identified ultrasound guided landmarks and this can provide prolonged analgesia with less risk when compared with any other regional block techniques.[20]

#### Conclusion

Ultrasound guided Erector spinae plane (ESP) block performed for postop analgesia in Laparoscopic cholecystectomy (LC) decreased consumption of analgesic in first 24 hr and delayed the time of 1<sup>st</sup> analgesia request compared to OSTAP block.

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