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Original Article

Anaesthesia Section

Comparison of Analgesic Efficacy of Erector Spinae and Oblique Subcostal Transverse Abdominis Plane Block in Laparoscopic Cholecystectomy

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ABSTRACT

Introduction: The pain after Laparoscopic Cholecystectomy (LC) which has both somatic and visceral component. Interfascial plane blocks play a major role in Multimodal Analgesia (MMA). Previous studies have found good analgesic benefits with Erector Spinae Plane (ESP) and Oblique Subcostal Transversus Abdominis Plane (OSTAP) blocks. However, till date no study exists which compares the above blocks with addition of dexamethasone.

Aim: To compare ESP with OSTAP block using low concentration of Local Anaesthetic (LA) and dexamethasone as part of MMA in elective LC.

Materials and Methods: A total of 66 patients were included in this study and finally, 60 patients were analysed. They were randomised to receive either bilateral ESP at T7 level or bilateral OSTAP with 20 mL 0.2% ropivacaine and 4 mg dexamethasone before starting anaesthesia. Primary outcome measures were total opioid consumption and mean Visual Analog Scale (VAS) in the first 24 hours postoperatively. Secondary outcome measures were intraoperative opioid consumption, opioids or block related complication, and patients' feedback for procedural satisfaction and postoperative pain control. The results were analysed using the Statistical Package for the Social Sciences (SPSS) software version 23.0. Continuous and categorical data were analysed using appropriate statistical analysis. A p-value <0.05 was considered statistically significant.

Results: Both the blocks provided excellent pain relief. The mean (24 hours) opioid consumption in ESP group was 29.83±54.74 mg and in OSTAP group was 73.17±94.04 mg; p=0.034. The mean VAS was significantly lower in the ESP block at all point of time during first 24 hours in ESP group was 0.58 and in OSTAP group was 1.72 (p<0.001). The mean intraoperative opioid requirement in ESP and OSTAP group were 6.9±1.8 mg and 7.6±2.3 mg of nalbuphine, respectively. No complications were noted in any patients.

Conclusion: Addition of dexamethasone in ESP block provides significant analgesia and less opioid consumption in patients undergoing LC. Hence, ESP block can be considered as part of MMA in LC surgery.

Keywords: Laparoscopy, Multimodal approach, Nerve block, Ultrasound

INTRODUCTION

The LC is a commonly performed surgery and requires MMA for better control of pain [1,2]. The pain can be in the form of somatic abdominal pain from the port sites, visceral pain from pneumoperitoneum and surgical manipulation of the viscera and surrounding tissue and even can be referred. Untreated postoperative pain has many consequences, including patient dissatisfaction, transition into chronic pain, delayed discharge from the hospital and increased healthcare costs [3,4].

Despite recent advances, majority of the patients still experience pain in the postoperative period and is one of the independent predictors for transition into chronic pain [4,5]. Hence, adequate Postoperative Pain Management (POPM) is a major issue and challenge for the anaesthesiologists. In recent times, the consensus and recommendation is to use a MMA approach where different drugs and regional analgesia techniques are employed to achieve satisfactory pain control and reduce opioid-related side-effects [6,7].

In recent times, many interfascial plane blocks like Transversus Abdominis Plane (TAP) block, OSTAP and very recently, ESP block has been utilised as part of MMA technique in many abdominal surgeries [8,9]. Ultrasound has facilitated the accurate identification of the fascial planes and deposition LA for a safe conduct of the block. Previous studies have found good analgesic efficacy of ESP as well as OSTAP block in the setting of elective LC with ESP block performing better than OSTAP [10-13]. ESP block was found to be effective in managing postoperative pain in LC [10]. In this study, the efficacy of above two procedures was compared with addition of dexamethasone with LA for POPM in LC.

The aim of this study was to compare the analgesic efficacy of ESP with OSTAP block using low concentration of LA (0.2% ropivacaine) with addition of dexamethasone in patients undergoing elective LC.

MATERIALS AND METHODS

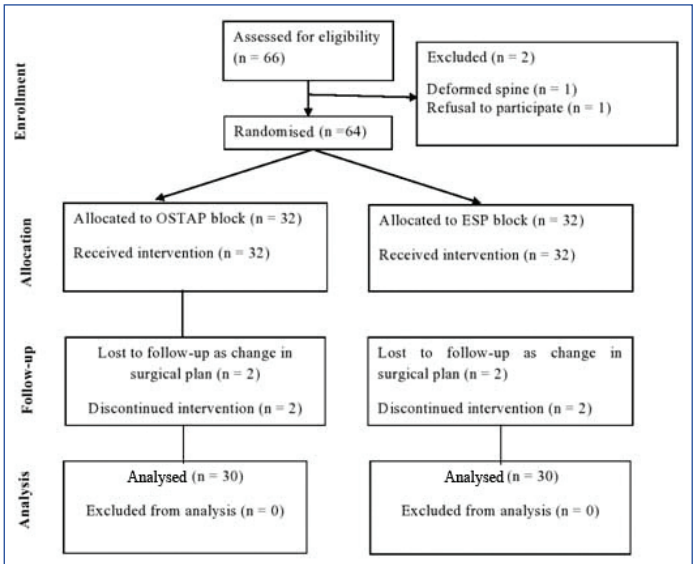
This single blind, randomised clinical study was conducted after approval of the Institutional Ethics Committee (KIIT/ KIMS/ IEC/ 235/ 2020 dated 04/02/2020). The study was registered with the Clinical Trials Registry of India (CTRI/2020/02/023451 dated 19/02/2020) and was conducted in a tertiary care academic hospital, between January 2021 and May 2021.

Inclusion criteria: Patients of either sex, aged between 18-70 years belonging to American Society of Anaesthesiologists (ASA) physical status I and II posted for elective LC were included in the study.

Exclusion criteria: Patients with infection at the regional block site, known allergy to LA, chronic opioid consumption, bleeding disorder or anticoagulation use, conversion to open cholecystectomy or change of surgical plan, presence of severe hepatic or renal disorder, severe psychiatric illness or previous upper abdominal surgery, any deformity in spine were excluded from the study.

A total of 66 patients meeting the inclusion criteria were enrolled in the study [Table/Fig-1]. Written informed consent was obtained

from all the participants. For calculating the power of the study, a pilot study with an effect size 0.86, power of 0.90 and significance level 0.05 was considered, and sample size was calculated as 60 with the help of G*3 power statistical software when compared with independent t-test. Taking dropout rate 10%, the calculated total sample size was 66 (i.e., 33 in each group).



[Table/Fig-1]: CONSORT flow diagram for enrollment, group allocation, follow-up and analysis.

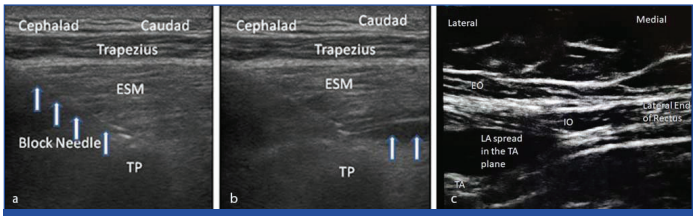
A computer generated randomisation list was prepared and patients were allocated to either of the two groups (ESP/OSTAP) by opaque sealed envelope technique. The envelope was opened just before the procedure by the anaesthesiologist performing the regional block. All the blocks were performed by a single anaesthesiologist under ultrasound guidance who was not involved in the anaesthesia management, data collection and analysis. The blocks were performed in the awake condition before the start of the anaesthesia; hence, patients could not be blinded. The nurses in Post Anaesthesia Care Unit (PACU), and the anaesthesiologists providing anaesthesia care in the operating room and data collection in the postoperative period were unaware of the type of regional block.

As per the institutional protocol, routine investigations and preoperative anaesthesia check-up was carried out for each patient. On the day before surgery, all the patients were explained and taught about the use of 11-point VAS (0 being no pain and 10 being the worst pain imaginable) for the assessment of their pain.

Anaesthesia management in both the groups was similar. Standard monitors like Electrocardiogram (ECG), Non Invasive Blood Pressure (NIBP) and pulse oximetry (SpO_2) were attached to the patient. After recording the baseline vitals, patients were premedicated with injection glycopyrrolate 0.2 mg, and injection midazolam 1 mg intravenous (i.v.). Then, according to group allocation, either bilateral ESP or bilateral OSTAP block was performed. The blocks were performed using Fujifilm Sonosite Edge II portable ultrasound machine and high frequency linear probe (6-13 MHz) under strict aseptic precautions. A 22 gauge 10 cm long nerve block needle (Stimuplex, B-Braun Melsungen Germany) was used for performing the regional block.

The ESP block was performed in sitting position. With ultrasound, the T7 transverse process was marked after counting from 12th rib. The ultrasound probe was placed 2-3 cm lateral to the T7 spinous process and placed over the T7/T8 transverse process in the parasagittal longitudinal plane and erector spinae muscle was identified over the transverse process [Table/Fig-2a,b]. Then, the block needle was inserted in-plane from cephalad to caudad until the needle tip hits T7 transverse process. After hydrodissection with 2 mL of isotonic saline appreciating the lifting of erector spinae muscle, 20 mL of 0.2% ropivacaine and 4 mg dexamethasone solution was injected after repeated negative aspiration. The same procedure was repeated on the other side.

The OSTAP block was performed in the supine position, at the inferior border of costal margin. The rectus muscle, transversus abdominis, internal and external muscles were identified after a thorough scanning [Table/Fig-2c]. Then, 20 mL of 0.2% ropivacaine and 4 mg of dexamethasone was deposited in the fascial plane between transversus abdominis and internal oblique at the lateral edge of the rectus abdominis muscle. The block was similarly repeated on the other side with same volume.



[Table/Fig-2]: a,b) Shows sonoanatomy image of ESP block with local anaesthetic spread; c) Shows sonoanatomy image of OSTAP block with local anaesthetic spread. EO: External oblique; IO: Internal oblique; TA: Transversus abdominis; LA: Local anaesthetic; TP: Transverse process; ESM: Erector spinae muscle

Then, anaesthesia was started with 2-3 mg/kg propofol, nalbuphine 0.1 mg/kg and vecuronium 0.1 mg/kg followed by tracheal intubation. Anaesthesia was maintained with O_2, N_2O (1:2 ratio) and isoflurane of 0.8-1% in the vaporiser. A standard surgical protocol with four ports was performed. All the ports were performed at or above T10 dermatome. A 12 mm of Hg intraperitoneal pressure was created with carbon dioxide (CO_2) insufflation for the laparoscopy procedure. Intraoperative monitoring included ECG, SpO_2, NIBP, and capnograph ($EtCO_2$). Ventilator parameters were set to maintain $EtCO_2$ between 34-40 mm of Hg and peak airway pressure <30 cm of H_2O. Additional dose of 0.05 mg/kg of incremental dose of inj. nalbuphine (total not exceeding 0.2 mg/kg) was given i.v. if there was 20% increase in Heart Rate (HR) or mean blood pressure from the baseline. Towards the end of the surgery, all patients received injection ondansetron 4-8 mg and paracetamol 1 gm i.v. and then tracheal extubation was done after reversing the neuromuscular blockade. Subsequently, they were shifted to PACU for observation.

In the PACU, ECG, NIBP, and SpO_2 were monitored. Additionally, VAS pain score was recorded by another anaesthesiologist blinded to the study. Patients were discharged from PACU after achieving score >8 on Aldrete's recovery score [14].

A standardised POPM protocol was followed for all the patients. All the patients received i.v. paracetamol 1 gm 6th hourly (maximum 4 gm in 24 hours). The VAS pain score was measured at PACU, and then, every two hours for the first 24 hours by a blinded anaesthesiologist. Whenever VAS >3, i.v. tramadol at 1 mg/kg was given as 1st rescue analgesic. If the VAS persisted >3 one hour after i.v tramadol, then diclofenac 75 mg i.v. infusion was given as 2nd line analgesic.

Primary outcome measures were total amount of opioid consumption and mean VAS pain score in first 24 hours of postoperative period. Secondary outcome measures included intraoperative opioid requirement, demand for 2nd line rescue analgesic (diclofenac), opioid-related side-effects like nausea, vomiting, pruritus or others, LA or block related complications and patient satisfaction towards the regional blocks and postoperative pain control. After discharge from the hospital, patients' feedback was collected telephonically within 1-7 days. A 5 point (1-5) likert scale was used for the satisfaction measurement; 1 being worst satisfied and 5 being most satisfied. Two different parameters were included for obtaining patients' feedback: their subjective experience during the performance of the block and their experience of pain management postoperatively.

STATISTICAL ANALYSIS

For continuous variables, the data were expressed as mean±Standard Deviation (SD) and the categorical variables were presented as frequency and percentage. For comparing categorical data, Chi-square test was performed. Independent t-test was used to test the significance in mean difference between two groups. All statistical calculations were performed using the SPSS software version 23.0 and p-value <0.05 was considered as statistically significant.

RESULTS

Total 66 patients were enrolled in the study; out of which one patient refused to participate and one patient with scoliosis was excluded from the study. Four patients were excluded due to change in the surgical plan. Finally, 30 patients from each group were analysed for the study. The demographic data, surgical duration and intraoperative opioid requirement (nalbuphine) were comparable between the two groups [Table/Fig-3].

Parameters		ESP	OSTAP	p-value (Independent t-test)
Age (years) (Mean±SD)		41.3±11.8	40.3±11.1	0.736
Sex	Male, n (%)	19 (63.3)	16 (53.3)	0.432*
	Female, n (%)	11 (36.7)	14 (46.7)	
BMI (kg/m^2) (Mean±SD)		23.2±3.3	23.4±2.4	0.752
Duration of surgery (minutes) (Mean±SD)		55.8±10.3	56.0±10.1	0.950
Intraoperative Nalbuphine (mg) requirement (Mean±SD)		6.9±1.8	7.6±2.3	0.174

[Table/Fig-3]: Descriptive variables of the groups.
Independent t-test and *Chi-square test was used to calculate the p-value; ESP: Erector spinae plane; OSTAP: Oblique subcostal transversus abdominis plane; SD: Standard deviation; BMI: Body mass index; kg: Kilogram; m: Metre; mg: Milligram

[Table/Fig-4] shows 24 hours opioid consumption and requirement of rescue analgesics. The total opioid requirement during first 24 hours was significantly less in ESP group than OSTAP group (29.83±54.74 mg vs 73.17±94.04 mg; p=0.034). Out of 60 patients, 22 (8 from ESP group and 14 from OSTAP group) required tramadol and 12 patients (eight from ESP group and four from OSTAP group) required diclofenac as rescue analgesics in the first 24 hours postoperatively.

Parameters	ESP (n=30)	OSTAP (n=30)	p-value (Independent t-test)
Total Tramadol requirement in first 24 hours (mg) (Mean±SD)	29.83±54.74	73.17±94.04	0.034*
Number of patients requiring Tramadol in first 24 Hours, n (%)	08 (26.67)	14 (46.67)	0.092
Number of patients requiring Diclofenac in first 24 Hours, n (%)	08 (26.7)	04 (13.3)	0.333

[Table/Fig-4]: Postoperative analgesic requirement.
ESP: Erector spinae plane; OSTAP: Oblique subcostal transversus abdominis plane; SD: Standard deviation; mg: Milligram; *p<0.05 is significant

The VAS pain score was assessed two hourly for first 24 hours. None of the patients complained of severe pain (VAS>7). In 38 patients (22 from ESP group and 16 from OSTAP group), the VAS remained below 3 and did not require any rescue analgesics. [Table/Fig-5,6] show the comparison of average VAS score between the two groups. The mean VAS was significantly less in ESP group at all point of time (p<0.05) in the first 24 hours.

[Table/Fig-6] shows the comparison of satisfaction towards regional nerve block between two groups. The patients from ESP group were more satisfied with the POPM (4.3±0.9 vs 3.8±0.9, p=0.044), but patients from OSTAP were more satisfied with the procedural performance (3.8±1.1 vs 4.7±0.7, p=0.001). There was no incidence of block related complications like haematoma, pneumothorax and

Time (in hours)	Mean value of VAS		p-value (Independent t-test)
	ESP	OSTAP	
2	1.60	2.27	0.029
4	1.17	2.73	<0.001
6	0.90	2.33	<0.001
8	0.33	1.80	<0.001
10	0.60	1.87	<0.001
12	0.83	2.23	<0.001
14	0.83	1.70	0.004
16	0.20	1.67	<0.001
18	0.13	1.23	<0.001
20	0.17	1.07	<0.001
22	0.10	1.10	<0.001
24	0.10	0.70	0.001
Overall mean	0.58	1.72	<0.001

[Table/Fig-5]: Mean VAS pain score in first 24 hours of postoperative period.
VAS: Visual analogue score; ESP: Erector spinae plane; OSTAP: Oblique subcostal transversus abdominis plane

Parameters	ESP	OSTAP	p-value (Independent t-test)
Postoperative pain control satisfaction (Mean±SD)	4.3±0.9	3.8±0.9	0.044
Procedural satisfaction score (Mean±SD)	3.8±1.1	4.7±0.7	0.001
Nausea (n, %)	06 (20.0)	03 (10.0)	0.432

[Table/Fig-6]: Comparison of satisfaction score and incidence of nausea.
ESP: Erector spinae plane; OSTAP: Oblique subcostal transversus abdominis plane; SD: Standard deviation; *p<0.05 is significant

LA related complications. Total nine patients developed nausea (six from ESP and three from OSTAP) and were treated with ondansetron. However, this was not statistically significant (p=0.432)

DISCUSSION

This single blind randomised controlled study compared the analgesic efficacy of ESP with OSTAP in the setting of elective LC using low concentration of LA (0.2% ropivacaine) with dexamethasone. There was significant decrease in VAS pain score in the ESP group during the first 24 hours. The total opioid (tramadol) consumption during first 24 hours was significantly less in the ESP group. Furthermore, the participants of ESP group were more satisfied with the postoperative pain control.

In LC, the postoperative pain has two components. First is somatic pain which arises from abdominal wall trauma due to the ports. The second part is the visceral pain arising due to gall bladder resection, stretching of peritoneum due to pneumoperitoneum. This is a dull aching pain and may cause referred pain to the right shoulder. Hence, the components MMA for POPM in LC should able to control both type of pain. Regional nerve blocks including interfascial plane blocks play a great role in MMA and are opioid-sparing; thus reducing the opioid related side-effects and help in faster discharge from the hospital [15,16].

Commonly practiced regional blocks for LC include TAP, OSTAP, ESP and rectus sheath block [9,17]. Except ESP block, all others provide analgesia only for the somatic pain arising from abdominal wall. However, ESP block has been found to provide visceral analgesia as well [18]. This is based on studies showing extensive spread of the dye not only to involve the dorsal ramus but also staining the ventral ramus and sympathetic chain [18-20]. However, LA spread following ESP block is conflicting and other studies have shown unpredictable dye spread [21].

In a similar study, Tulgar S et al., compared the effect of ESP block with OSTAP block and control group in LC patients [13]. They found

that patients in both the block groups had required significantly less amount of tramadol postoperatively and the VAS (both static and during coughing) was significantly less for first three hours in these two block groups in comparison to control group. But they found no significant difference in postoperative tramadol requirement and VAS pain score between these two block groups. In contrast, in present study, authors found ESP block to be better in terms of 24 hours opioids requirement as well as mean VAS score over 24 hours. Additionally, authors observed good analgesia even with lower concentration of LA (0.2% ropivacaine).

Altıparmak B et al., compared the efficacy of ESP and OSTAP in LC [12]. They used 20 mL of 0.375% bupivacaine for their blocks. They also found that the postoperative tramadol requirement was significantly lower in the ESP group and VAS score was lower in ESP group compared to OSTAP group. Other studies also found good analgesic efficacy with ESP block compared to placebo or OSTAP and time for first analgesic request were longer in ESP group [22,23].

Present study was different from all the above studies [12,13,22,23] in two aspects: Authors used much lower concentration (0.2% ropivacaine) and added dexamethasone in both block groups. LA toxicity is a life threatening condition and is possible when injecting high volume LA, more so during these interfascial plane blocks. As muscles are highly vascular; the possibility of LA toxicity is high. Hence, it is recommended that the lowest possible effective volume and concentration of LA be used in these blocks [24]. Having said this, further studies with large number of patients need to be carried out to determine the effective volume and concentration of LA for safe conduct of these blocks. Another important finding in present study was first 24 hours tramadol consumption (cumulative tramadol in mg). This was again much lower compared to other studies [12,13,22,23]. This could be possibly because of addition of dexamethasone in our blocks which was not studied in the above mentioned studies. Dexamethasone when added to TAP block has been found to provide longer duration of analgesia, and lesser opioid consumption in the postoperative period [25-27]. Authors also took patients' feedback towards the blocks and many patients were satisfied with ESP block in terms of pain control; however, patients expressed satisfaction for OSTAP block as far as procedural satisfaction was concerned. This could possibly be because of injection in their back, sitting position and possibly more discomfort from touch of periosteum with the needle tip when performing ESP block.

Limitation(s)

This was a single blinded comparative study without any control group. It was difficult to blind the patients as the injection sites were different in both groups and blocks were performed prior to induction of anaesthesia. The extent of sensory blockade was not evaluated. This could have given us idea about the extent of spread and possible block failures. Only VAS pain score at rest was measured. VAS score during coughing or movement would have given further insight into the analgesic efficacy. Finally, the actual effect of these blocks in facilitating earlier hospital discharge could not be studied.

CONCLUSION(S)

The ESP block significantly decreases the postoperative opioid requirement and VAS pain score in LC patients when compared with the OSTAP block. It was demonstrated that lower concentration of LA is also equally efficacious and addition of dexamethasone to the blocks may reduce the postoperative opioid consumption significantly. The ESP block can be considered as a part of MMA technique for POPM in LC. However, further studies with large number of patients are needed to confirm present study findings. An optimal dose finding study is also the need of the hour. Finally, further study should be considered to see if these blocks facilitate earlier hospital discharge.

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