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Postoperative analgesia in Laparoscopic Cholecystectomy - Oblique Subcostal-Transverse Abdominis Planes versus Erector Spinae Block - A prospective comparative study.

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Abstract

Background and aim: Laparoscopic cholecystectomy despite being a minimally invasive surgery can s6ll be associated with moderate to severe postopera6ve pain. Peripheral nerve blocks like oblique subcostal trans versus abdominis plane block and erector spinae plane block are becoming increasingly popular choice for pain management.

This study compared the efficacy of USG guided oblique subcostal transversus abdominis plane block and erector spinae plane block for post opera6ve analgesia in laparoscopic cholecy st ectomy.

Method: A prospec6ve comparative study was done on 50 pa6ents, with American Society of Anaesthesio logists (ASA) physical status I-III, aged between 18-60 years undergoing laparoscopic cholecystectomy under general anaesthesia. Pa6ents were randomly allocated into two equal groups of 25 each, to receive either bilateral OSTAP block (group T 20ml of inj.

Ropivacaine 0.375% and 4 mg dexamethasone) or bilateral erector spinae plane block (group E 20 ml of inj. Ropivacaine 0.375% and dexamethasone 4 mg) Ayer completion of surgery before extuba6on. Duration of postoperative analgesia, total analgesic consumption in first 24 hours. Pain scores and patient satisfaction scores were recorded and analyzed.

Result: Group E had significantly longer duration of analgesia as compared to group T (21.48± 2.551 v/s 12.96± 4.800 h respectively, p-value = 0.0001). Total

analgesic consumption was lower in group E when compared to group T.

Conclusion: USG guided ESP block is more effective when compared to OSTAP block in laparoscopic cholecystectomy. Addition of a steroid to local Anaesthetic drug not only prolongs the dura6on of post operative analgesia but also renders it opioid free.

Keywords: Analgesia, Cholecystectomy, Laparoscopic, Nerve Block

Introduction

Laparoscopic cholecystectomy is an increasingly popular choice for treatment of symptomatic gallbladder diseases such as cholecystis and cholelithiasis. Despite being a minimally invasive surgery, it is still associated with moderate to severe postoperative pain which may be visceral or somatic. [1]

Postoperative pain associated with upper abdominal surgeries, particularly those along the subcostal margins may lead to development of postoperative pulmonary complications like atelectasis, pneumonia, respiratory failure etc. which can increase morbidity and lead to longer hospital stay. [2]

Laparoscopic cholecystectomies are usually performed under general anaesthesia. There are multiple options available for postoperative analgesia like intravenous opioids, NSAIDS (nonsteroidal anti - inflammatory drugs), epidural analgesia, local infiltration.

Concomitant use of regional anaesthesia and peripheral nerve blocks can effectively alleviate this pain and also reduce the need for postoperative opioid consumption thereby, helping to avoid unwanted side effects like respiratory depression, sedation, urinary retention, delayed Ambul ation etc. [3]

The oblique subcostal TAP block is a modified subcostal TAP block, in which by hydro dissecting the Anaesthetic solution along the oblique subcostal line (from the xiphoid toward the anterior part of the iliac crest), the anesthetic solution was spread across the location of T6-L1 nerves to potentially cover both upper and lower abdominal walls.

It requires only a single penetration through the subcostal approach, but it covers both upper and lower TAP plexuses like a dual TAP block, it cannot be classified into either one of these two groups appropriately. Thus, the oblique subcostal TAP block should be categorized as an independent, specific technique for TAP block. [4]

Ultrasound guided erector spinae (ESP) block can also provide analgesic effect on visceral and somatic pain relief by blocking the ventral rami and rami communi cants involving sympathetic nerve fibers. It provides effective postoperative analgesia when performed at T4-5 level for thoracic and breast surgery, and T 7 level for abdominal surgeries. [5,6]

To prolong the duration and effect of local Anaesthetic drug, many adjuvants have been used which also improves the efficacy and latency of onset. Dexa metha sone is a commonly used adjuvant which prolongs dura tion of nerve blocks when used along with local Anaesthetic agents.

This property is agributed to its anti- inflammatory action. It causes alteration in release of inflammatory mediators, decreases the ectopic neuronal discharge, and inhibits discharge of nociceptive C fibres which is mediated by potassium channels.

In our study, we used dexamethasone as common adjuvant in both oblique subcostal TAP block and ESP block to avoid any bias with respect to adjuvant. We hypothesized that effect of erector spinae block for post operative analgesia will be comparable with effect of Transversus abdominis plane block.

Our primary objective was to note the duration of postoperative analgesia. Secondary objectives included

total rescue analgesic consumption in first 24 h and patients' satisfaction score.

Method

We conducted this prospective, randomized, study at a tertiary care center from September 2022 to February 2023, Ayer obtaining approval from the Institutional Ethics Commigee (No: F. 29 (Acad) SPMC/ 2022/ 2661) and Clinical trial registration (CTRI No. CTRI/ 2022/ 08/044634).

Wrigen informed consent from the patient and relatives was obtained and they were explained thoroughly about the entire procedure and outcomes. FiYy patients of American Society of Anaesthesio logists (ASA) physical status I-III, aged 18 to 60 years of either sex, scheduled for laparoscopic cholecystectomy were randomly allocated to two groups of 25 patients each using a computer-generated randomization chart gene rated via MS-Excel soy ware.

The sample size for the study was based on Sahoo et al, [7] who reported the mean post operative analgesia in the two groups as follows

Parameter	
Group 1: Mean ± SD	Group 2: Mean ± SD
374.15±30.55	294.61±43.18

The sample size required in each arm of the study was calculated according to the formula given by Snedecor & Cochran [8]:

$$\text{Sample size (N)} = 1 + \frac{2(Z_\alpha + Z_{1-\beta})^2 \sigma^2}{\delta^2}$$

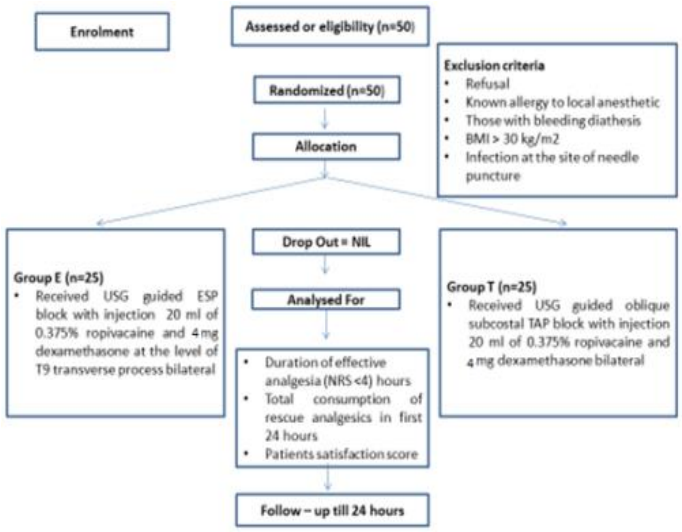
Where: σ (Pooled SD) = 37.40, δ (Difference of Means) = 79.54. However, we have planned a study which is adequate to detect a difference of as low as 30.

Type I error (α) = 5%, Zα (Value of Standard Normal Distribu6on for α = 5%) = 1.96. Type II error (β) = 20%, Power (1 – β) = 80%, Z1-β = 0.842. Based on the formula given above, using the mentioned values, the sample size required is:

$$\text{Sample size (N)} = 1 + \frac{2(1.96 + 0.842)^2 37.4^2}{30^2} = 25.4$$

Thus, assuming 80% Power and 95% Confidence interval, we took 25 patients in each group as our sample size. The Consort flow diagram shows the description of methodology and analysis [Figure 1]

Figure 1: Consort Diagram of the study



Exclusion criteria included patient's refusal, ASA physical status >III, history of bleeding and coagulation disorder, BMI >30 Kg.m-2, allergy to local Anaesthetic agents, infection at local site, neurological disease, or psychiatric disorder.

Detailed preoperative assessment with all rou6ne investigations were done a day prior to surgery. To our patients we explained, grading of pain according to NRS scale in their own language. Nil by mouth for at least 6 hours prior to surgery was ensured for all patients.

Ayer wheeling in the pa6ent, Standard monitors including pulse oximetry, five lead ECG, ETCO2, gas monitoring and non-invasive blood pressure were

connected. IV cannulation was done, and Ringer's lactate (15ml.Kg-1) was started. All patients were premedicated with intravenous midazolam 0.04 mg. Kg-1 and fentanyl 2 µg. Kg-1. Baseline vitals (Pulse rate, Systolic, Diastolic, Mean arterial pressure, SpO2).

General anaesthesia was Sample size (N) = 1 + 2 (1.96 + 0.842) 2 37.42 302 = 25.4 induced with inj. propofol 2-3mg.Kg-1 and maintained with oxygen, vecuronium and sevo flurane.

Ayer completion of surgery, under sterile aseptic precautions, patients received, Group E (n= 25): USG guided ESP block Ayer placing transducer longitudinally 2.5- 3 cm lateral to T9 spinous process level using, bilaterally with 20 ml of Inj.

Ropivacaine 0.375% and 1 ml (4mg) dexamethasone (total volume 21 ml on each side) in lateral position and, Group T (n= 25): OS-TAP block Ayer placing transducer obliquely just below the subcostal margin bilaterally with 20 ml of inj. Ropivacaine 0.375% and 1 ml (4mg) dexamethasone (total volume 21 ml on each side) in supine position using a high frequency (6-15 MHz) linear transducer probe and echoplex +21 G 10cm needle using an in-plane approach. The block was performed by an experienced anaesthesia consultant with good hands-on knowledge of USG.

Pa6ents were extubated on fulfilling reversal criteria Ayer giving Inj. neos6gmine (0.04 mg. Kg-1) and Inj. glycopyrrolate (0. 005mg.Kg-1) and vitals parameters noted in the postoperative period.

Postoperative pain was assessed using the numerical rating scale (NRS) score. NRS ranges from 0 means no pain to 10 means extreme pain. NRS scores were recorded at the 20 min, 40 min, 1 h, 3 h, 6 h, 9 h, 12 h, 15 h,18 h, 21 h and 24 h post operatively both at rest and while coughing.

Duration of postoperative analgesia, total analgesic consumption in 24 h and patient satisfaction scores (Excellent/ good/ fair/ poor) were also recorded. Post operative nausea and vomiting were assessed by using a 4-point scale (0-none, 1-mild, 2-moderate, 3-severe).

Inj. tramadol 100 mg IV was given as rescue analgesic when NRS score >4. Data was coded and recorded in MS Excel spreadsheet program. SPSS v23 (IBM Corp.) was used for data analysis.

Descriptive statistics were elaborated in the form of means/standard deviations and medians/IQRs for con6nuous variables, and frequencies and percentages for categorical variables. Data will be presented in a graphical manner wherever appropriate for data visualiza6on using histograms/ box-and-whisker plots/ column charts for con6nuous data and bar charts/ pie charts for categorical data.

Group comparisons for continuously distributed data will be made using independent sample 't' test when comparing two groups, and One-Way ANOVA when comparing more than two groups. Post-Hoc pairwise analysis was performed using Tukey's HSD test in case of One-Way ANOVA to control for alpha inflation.

If data was found to be non-normally distributed, appropriate non parametric tests in the form of Wilcoxon Test/Kruskal Wallis test was used for these comparisons. Chi-squared test was used for group comparisons for categorical data. In case the expected frequency in the contingency tables were found to be 25% of the cells, Fisher's Exact test will be used instead.

Linear correlation between two continuous variables was explored using Pearson's correlation (if the data was normally distributed) and Spearman's cor relation (for non-normally distributed data). Sta6s6cal significance was kept at $p < 0.05$.

Results

Demographic profile of patients across both the groups was comparable. [Table 1]

Table 1: Demographic profile of Study Partcipants.

Parameters	Group E (n=25)	Group T (n=25)	p value
Age (years)	43.76±14.131	43.28±11.216	0.895
Gender			
Male	7	2	0.066
Female	18	23	
BMI (Kg.m^{-2})			
18.5-24.9	23	23	1.0
25.0-29.9	2	2	
ASA grade			
I	18	21	0.310
II	5	4	
III	2	0	

*t-test, Pearson, chi-square test the mean NRS score at rest was lower in group E as compared to group T. In first 18 h, the difference was statistically significant (p value = 0.010). Ayer that since patients required rescue analgesic the difference became comparable between both groups. Similarly, NRS scores while coughing was significantly lower in group E as compared to group T (p value <0.05) 6ll 12 h. Ayer that as patients required rescue analgesia so differences became comparable in both groups.

Duration of analgesia in group E was 21.48±2.55 h while in group T was 12.96±4.80 h. The difference between both groups was highly statistically significant (p value = 0.0001) [Table 2].

Table 2: Duration of analgesia (NRS<4) [h] in both groups.

Group	N	Mean ±Std. Deviation	p value
E	25	21.48 ±2.551	0.0001
T	25	12.96±4.800	

*Unpaired t-test in group E, no rescue analgesia was required in 11 subjects and one dose of rescue analgesic was required in 14 subjects. However, in group T, no rescue analgesia was required in 2 subjects, one dose of rescue analgesic required in 19 subjects and two doses were required in 4 subjects. This difference was also statistically significant (p value=0.04) [Table 3].

Table 3: No. of rescue analgesics consumed in first 24 h in both groups.

	Group					
No. of rescue analgesic consumed in 24 h	E	Percent	T	Percent	Total	p value
0	11	84.62%	2	15.38%	13	0.04
1	14	42.42%	19	57.58%	33	
2	0	0%	4	100%	4	
	25		25		50	

*Pearson, chi-square test the total consumption of rescue analgesic in first 24 hours in group E, was 0.56±0.507 but in group T, was 1.08±0.493 and this difference was statistically significant (p value=0.001) [Table 4].

Table 4: Total consumption of rescue analgesic in first 24 h.

Group	N	Mean	Std. Deviation	p value
E	25	0.56	0.507	**0.001**
T	25	1.08	0.493	

*Unpaired t-test

In group E, patient satisfaction scores were excellent in 15 and good in 10 out of 25 patients. In group T patients satisfaction score was excellent in 4 and good in 21 patients. The difference between both the groups was highly statistically significant (p value=0.001) [Table 5].

Table 5: Distribution of cases according to Patient's satisfaction score.

Patient's satisfaction score	Group		Total	p value
	E	T		
Excellent	15	4	19	0.001
Good	10	21	31	
Fair	0	0	0	
Total	25	25	50	

*Pearson, chi-square test

Discussion

USG guided ESP (erector spinae plane) block provides an edge over TAP (transversus abdominis plane) block as it can provide both somatic and visceral analgesia while oblique subcostal TAP block provides only somatic analgesia. ESP block (a more central approach) provide beger pain relief than oblique subcostal TAP block (peri pheral approach). The reason behind same may be discontinuity of the intercostal muscles leading to local Anaesthetic drug diffusing anteriorly to the dorsal and ventral rami of the spinal nerves and through the inter transverse connective tissue to enter the thoracic para vertebral space.

In our study, duration of effective analgesia in first 24 h was significantly higher in group E (21h) as compared to group T (12h). Our study had findings similar to studies by Rou tray et al, who found that the duration of analgesia was significantly higher in group ESP (360.34 ± 28.94 min) as compared to group OSTAP (280.51 ± 45.66 min) and Sahoo et al who also found that the duration of effective analgesia was significantly higher in group ESP (374.15±30.55 min) as compared to group OSTAP (294.61±43.18 min). [7,9] We used dexa metha sone as adjuvant along with ropivacaine, and the above stated studies used only plain bupivacaine without any adjuvants. [7-9] This may be the reason why duration of analgesia is much more prolonged in our study as compared to these peer studies. However, since Ayer 12 h duration of block, patients received rescue analgesia, p-value became insignificant between the two groups. Our results are in concordance with study by Altiparmak et al who also found lower NRS scores in ESP group as compared to OSTAP group in first hour. [10] Similarly, Tulgar et al also found that the mean NRS scores at rest and while coughing was statistically significant in first three hours (p value0.05). [11] There was another study that found that NRS scores both at rest and during coughing were significantly lower in group ESP compared to group OSTAP during the first 6 hours (p-value <0.05) Ayer that NRS scores were comparable in both groups. [9] The prolonged duration in our study could be because of dexamethasone as adjuvant while in most of other studies adjuvants were not added.

Abdel Wahab et al did a study in which patients received either USG guided bilateral TAP block with 0.25% bupivacaine (0.3 ml. Kg-1) and dexamethasone (0.3 mg. Kg-1) or 0.25% bupivacaine (0.3 ml. Kg-1) and volume of saline equal to dexamethasone. They evaluated the safety and efficacy of adding dexamethasone to bupi vacaine on the quality of bilateral Ultrasound guided Transverse Abdominis Plane block and concluded that adding dexamethasone to bupivacaine significantly reduces postoperative pain and requirement of analgesia

as compared to bupivacaine alone in children undergoing major abdominal surgery.[12]

Total consumption of rescue analgesics in first 24 h in group E was significantly lower than group T. Number of rescue analgesics were lower in group E as compared to group T. Our results are similar to Sahoo et al, Tulgar et al and Rout ray et al who also concluded that total con Sumption of rescue analgesic was significantly reduced with use of ESP block thereby providing superior quality analgesia as compared to oblique subcostal TAP block. [7,9,11].

Patients' satisfaction scores were berger with ESP and difference between both the groups was highly statisti cally significant (p value=0.001).

The oblique subcostal TAP block may be associated with vascular injury, abdominal wall hematoma and local anesthetic toxicity. [13,14] However, we did not encounter any such complication in our study. Com plications of USG guided ESP block are pneumothorax and motor weakness when performed at lower thoracic level. [15,16] However, we did not encounter any such complication in our study. Our study had few limitations. It was a single center-based study. Most patients belonged to ASA grade I and II and only few patients were ASA grade III. The quantification of satisfaction scores by the patients is subjective entity. Therefore, a multi-centric model using non-subjective parameters to assess the efficacy of blocks and drugs are needed to berger substantiate the outcomes.

Conclusion

USG guided ESP block provides longer duration of anal gesia when compared to USG guided oblique subcostal TAP block in laparoscopic cholecystectomy.

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