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ORIGINAL ARTICLE

Comparison of Ultrasound-Guided Erector Spinae Plane Block and Oblique Subcostal Transversus Abdominis Plane Block in Post-Operative Pain Management for Laparoscopic Cholecystectomy Patients

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ABSTRACT

Background: Laparoscopic cholecystectomy is a frequently performed minimally invasive surgery associated with significant postoperative pain, which can delay recovery and increase opioid use. Regional anesthesia techniques such as the erector spinae plane (ESP) block and oblique subcostal transversus abdominis plane (OSTAP) block have been utilized to improve postoperative analgesia, but comparative data on their efficacy remain limited.

Objectives: To compare the analgesic efficacy of ultrasound-guided ESP block and OSTAP block in managing postoperative pain following laparoscopic cholecystectomy.

Study Design & Setting: This was a prospective, randomized, controlled study conducted at Department of Anaesthesia and Intensive Care NICVD from January 2023 to June 2023 involving 120 patients scheduled for elective laparoscopic cholecystectomy.

Methodology: Patients aged 18–65 years with ASA physical status I or II were randomly assigned to receive either ESP block (Group A) or OSTAP block (Group B) preoperatively. Both groups received 20 ml of 0.25% bupivacaine under ultrasound guidance. Postoperative pain was assessed using the Visual Analog Scale (VAS) at rest and during coughing at 1, 4, 8, 12, and 24 hours. Secondary outcomes included total opioid consumption in 24 hours, incidence of side effects, and patient satisfaction.

Results: Group A demonstrated significantly lower VAS pain scores at all time points both at rest and during coughing ($p < 0.005$). Total opioid consumption was also significantly reduced in Group A (8.7 ± 2.5 mg) compared to Group B (12.1 ± 3.4 mg) ($p < 0.001$). Side effects were comparable between groups without statistically significant differences.

Clinical Implication: The ESP block offers superior postoperative analgesia and opioid-sparing benefits, potentially improving recovery quality in laparoscopic cholecystectomy patients.

Conclusion: Ultrasound-guided ESP block is more effective than OSTAP block in reducing postoperative pain and opioid use, making it a preferable analgesic technique in laparoscopic cholecystectomy.

Keywords: Erector spinae plane block, laparoscopic cholecystectomy, opioid consumption, postoperative pain, transversus abdominis plane block

INTRODUCTION

Laparoscopic cholecystectomy (LC) is one of the most commonly performed abdominal surgeries, offering the advantage of minimally invasive techniques that lead to faster recovery times, shorter hospital stays, and fewer complications compared to open cholecystectomy.[1,2] Effective postoperative pain management is essential to enhance patient comfort, promote early mobilization, and reduce the risk of complications, such as deep vein thrombosis, atelectasis, and chronic pain.[3,4] Adequate pain control is crucial not only for the recovery of patients but also for minimizing opioid use, which is associated with various adverse effects including nausea, vomiting, and addiction.[5]

Regional anesthesia techniques, such as the erector spinae plane (ESP) block and the transversus abdominis plane (TAP) block, have gained popularity in recent years as effective methods of postoperative pain management in abdominal surgeries.[6,7] Both blocks offer targeted analgesia with minimal side effects and complications, making them attractive alternatives to systemic analgesia. However, despite their growing use, a direct comparison between ultrasound-guided ESP block and the oblique subcostal TAP block (OSTAP) for pain relief in laparoscopic cholecystectomy patients remains limited in the existing literature.[8]

The erector spinae plane block, first described by Forero et al. in 2016, is a fascial plane block that targets the ventral and dorsal rami of spinal nerves. The ESP block has been used for various types of surgeries, providing both somatic and visceral pain relief, especially for thoracic and abdominal surgeries. The technique is performed by injecting local anesthetics near the erector spinae muscle, which allows the local anesthetic to spread along the paravertebral space, blocking multiple nerve roots. In contrast, the oblique subcostal transversus abdominis plane block targets the anterior abdominal wall, blocking the sensory input from the peritoneum and abdominal muscles.[9] The OSTAP block involves the injection of local anesthetics into the plane between the internal oblique and transversus abdominis muscles, providing analgesia for abdominal procedures.[10,11]

While both blocks have shown promise for postoperative pain control, there is a need to compare their efficacy directly in the specific context of laparoscopic cholecystectomy. This study aims to compare the efficacy of ultrasound-guided ESP block and OSTAP block in managing postoperative pain for patients undergoing laparoscopic cholecystectomy. The primary outcome will focus on pain scores measured at multiple time intervals post-surgery, while secondary outcomes will include opioid consumption, side effects, and patient satisfaction. By comparing these two techniques, this study will contribute valuable insights into their relative effectiveness in improving postoperative pain management and offer guidance for anesthesiologists and surgeons in optimizing postoperative care for laparoscopic cholecystectomy patients.

MATERIALS AND METHODS

This prospective, randomized, controlled study was conducted at Department of Anaesthesia and Intensive Care NICVD from January 2023 to June 2023. The study included 120 patients who were scheduled to undergo elective laparoscopic cholecystectomy at a tertiary care hospital. The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants. The sample size of 120 patients was

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calculated based on an estimated difference in mean VAS scores between the two groups, with a power of 80% and a significance level of 0.05.

The inclusion criteria for the study were patients aged between 18 and 65 years, American Society of Anesthesiologists (ASA) physical status I and II, and those who were scheduled for elective laparoscopic cholecystectomy. Patients with a history of allergy to local anesthetics, pregnancy, contraindications to regional anesthesia (e.g., infection at the injection site or anticoagulant therapy), and those with neurological disorders or severe cardiopulmonary diseases were excluded from the study.

The patients were randomly assigned to one of two groups: Group A, which received the ultrasound-guided ESP block, and Group B, which received the ultrasound-guided OSTAP block. Randomization was done using a computer-generated random number table. In both groups, the block was performed preoperatively by the same anesthesiologist, who was blinded to the patient's group allocation. In Group A, the ESP block was performed by identifying the erector spinae muscle in the mid-thoracic region under ultrasound guidance. A 20 ml injection of 0.25% bupivacaine was administered into the fascial plane between the erector spinae muscle and the transverse process at the T8 level. In Group B, the OSTAP block was performed by identifying the plane between the internal oblique and transversus abdominis muscles in the subcostal region, and 20 ml of 0.25% bupivacaine was injected under ultrasound guidance.

Postoperative pain was assessed using the Visual Analog Scale (VAS) at rest and during coughing at multiple time points: 1 hour, 4 hours, 8 hours, 12 hours, and 24 hours after surgery. The primary outcome was the difference in pain scores between the two groups at each time interval. Secondary outcomes included total opioid consumption in the first 24 hours postoperatively, the incidence of side effects such as nausea, vomiting, and sedation, and patient satisfaction, which was assessed using a 5-point Likert scale. A minimum of 60 patients per group was required to detect a statistically significant difference in the primary outcome. This calculation was based on an expected reduction in pain scores of 2 points on the VAS scale, with a standard deviation of 3 points.

Data were analyzed using SPSS version 22.0. The normality of the data was assessed using the Shapiro-Wilk test. Between-group comparisons for continuous variables were performed using the independent t-test or Mann-Whitney U test, depending on the distribution of the data. Categorical variables were compared using the chi-square test or Fisher's exact test, where appropriate. A p-value of < 0.05 was considered statistically significant.

RESULTS

Table 1 presents the baseline demographic and clinical characteristics of the patients in both Group A (ESP block) and Group B (OSTAP block), each comprising 60 participants. The mean age of patients in Group A was 42.3 ± 10.5 years, while in Group B it was 43.7 ± 11.2 years ($p = 0.48$), indicating no significant age difference between the two groups. Gender distribution was also comparable, with 26 males (43.3%) and 34 females (56.7%) in Group A, and 29 males (48.3%) and 31 females (51.7%) in Group B ($p = 0.58$). The mean Body Mass Index (BMI) was 26.2 ± 3.9 kg/m² in the ESP group and 25.8 ± 4.1 kg/m² in the OSTAP group ($p = 0.56$), showing no statistically significant difference. Regarding ASA physical status, 35 patients (58.3%) in Group A and 32 (53.3%) in Group B were classified as ASA I, while 25 (41.7%) and 28 (46.7%) were ASA II, respectively ($p = 0.56$). The mean duration of surgery was similar between the groups, being 65.4 ± 12.6 minutes in Group A and 66.9 ± 13.4 minutes in Group B ($p = 0.43$).

Table 2 demonstrates that Group A (ESP block) had significantly lower postoperative VAS pain scores at rest compared to Group B (OSTAP block) at all assessed time intervals (1, 4, 8, 12, and 24 hours), with all p-values indicating statistical significance ($p \leq 0.002$).

Table 3 shows that postoperative VAS pain scores during coughing were significantly lower in Group A (ESP block) compared to Group B (OSTAP block) at all time intervals (1, 4, 8, 12, and 24 hours), with all differences reaching statistical significance ($p \leq 0.003$).

Table 4 indicates that total postoperative opioid consumption within the first 24 hours was significantly lower in Group A (ESP block) (8.7 ± 2.5 mg morphine equivalent) compared to Group B (OSTAP block) (12.1 ± 3.4 mg), with a statistically significant p-value of <0.001.

Table 5 shows the incidence of side effects in both groups. Nausea occurred in 7 patients (11.7%) in Group A and 12 patients (20%) in Group B ($p = 0.21$). Vomiting was reported in 3 patients (5%) in Group A and 8 patients (13.3%) in Group B ($p = 0.11$). Sedation occurred in 2 patients (3.3%) in Group A compared to 6 patients (10%) in Group B ($p = 0.14$). None of these differences were statistically significant

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 120)

Variable	Group A (ESP) (n = 60)	Group B (OSTAP) (n = 60)	p-value
Age (years), mean ± SD	42.3 ± 10.5	43.7 ± 11.2	0.48
Gender			
Male	26 (43.3%)	29 (48.3%)	0.58
Female	34 (56.7%)	31 (51.7%)	
BMI (kg/m²), mean ± SD	26.2 ± 3.9	25.8 ± 4.1	0.56
ASA Physical Status			
I	35 (58.3%)	32 (53.3%)	0.56
II	25 (41.7%)	28 (46.7%)	
Duration of surgery (min)	65.4 ± 12.6	66.9 ± 13.4	0.43

Table 2: Postoperative VAS Pain Scores at Rest

Time Interval	Group A (ESP)	Group B (OSTAP)	p-value
1 hour	2.8 ± 1.1	3.5 ± 1.2	0.002
4 hours	2.5 ± 1.0	3.3 ± 1.1	0.001
8 hours	2.3 ± 0.9	3.1 ± 1.0	<0.001
12 hours	1.8 ± 0.8	2.7 ± 1.1	<0.001
24 hours	1.1 ± 0.6	1.9 ± 0.9	<0.001

Table 3: Postoperative VAS Pain Scores During Coughing

Time Interval	Group A (ESP)	Group B (OSTAP)	p-value
1 hour	3.6 ± 1.3	4.4 ± 1.5	0.003
4 hours	3.3 ± 1.1	4.2 ± 1.4	0.001
8 hours	2.9 ± 1.0	3.9 ± 1.3	<0.001
12 hours	2.4 ± 1.0	3.3 ± 1.2	<0.001
24 hours	1.6 ± 0.7	2.4 ± 0.9	<0.001

Table 4: Postoperative Opioid Consumption in First 24 Hours

Outcome	Group A (ESP)	Group B (OSTAP)	p-value
Total opioid (mg morphine equivalent)	8.7 ± 2.5	12.1 ± 3.4	<0.001

Table 5: Incidence of Side Effects

Side Effect	Group A (ESP) (n=60)	Group B (OSTAP) (n=60)	p-value
Nausea	7 (11.7%)	12 (20%)	0.21
Vomiting	3 (5%)	8 (13.3%)	0.11
Sedation	2 (3.3%)	6 (10%)	0.14

DISCUSSION

Laparoscopic cholecystectomy is a commonly performed minimally invasive surgery often associated with significant postoperative pain. Effective pain management is essential to enhance recovery, reduce opioid consumption, and improve patient satisfaction. Regional anesthesia techniques like the erector spinae plane (ESP) block and oblique subcostal transversus abdominis plane (OSTAP) block have gained popularity for postoperative analgesia. Both blocks target different anatomical planes to provide effective pain relief after abdominal surgery. However, comparative data on their efficacy in laparoscopic cholecystectomy remain limited. This

study aims to evaluate and compare the analgesic efficacy of ultrasound-guided ESP and OSTAP blocks in this patient population.

Our study demonstrated significantly lower postoperative pain scores at rest and during coughing in the ESP group compared to the OSTAP group at all measured time points ($p < 0.01$), consistent with findings from previous studies. Specifically, our total opioid consumption over the first 24 hours was significantly reduced in the ESP group (8.7 ± 2.5 mg morphine equivalent) compared to the OSTAP group (12.1 ± 3.4 mg, $p < 0.001$), which aligns closely with Ali et al. (2023) who reported postoperative tramadol consumption of 144.26 ± 16.38 mg in the ESP group versus 200.58 ± 17.57 mg in the OSTAP group ($p < 0.001$).[15] Both studies highlight the superior analgesic efficacy of ESP blocks over OSTAP blocks in laparoscopic cholecystectomy. Similarly, Altıparmak et al. (2019) found a mean difference in tramadol consumption of 60.29 mg favoring ESP (139.1 ± 21.9 mg vs. 199.4 ± 27.7 mg, $p < 0.001$), along with consistently lower Numerical Rating Scale (NRS) scores in the ESP group across multiple time points. While they observed no significant time-wise difference in pain trajectory, their findings parallel our results, reinforcing the sustained analgesic benefit of ESP blocks.[16]

Ozdemir et al. (2022) reported lower NRS scores at rest and movement in the ESPB group at various intervals up to 24 hours ($p < 0.05$), and longer time to first analgesic request, reduced intraoperative and postoperative fentanyl requirements ($p < 0.0001$), as well as shorter PACU and hospital stays.[17] These outcomes complement our findings regarding reduced opioid consumption and better pain control with ESP blocks, although our study did not evaluate intraoperative opioid use or recovery milestones. Engineer et al. (2022) also noted lower pain scores up to 12 hours, longer analgesic duration, and reduced total analgesic consumption in the ESP group versus OSTAP group, consistent with our observations of improved postoperative analgesia with ESP blocks and minimal side effects.[18] Avci et al. (2024) demonstrated that the novel M-TAPA block resulted in significantly lower pain scores and opioid consumption compared to control, highlighting evolving regional techniques that may offer comparable or enhanced analgesia to TAP blocks. Although M-TAPA is distinct from OSTAP, their findings support the trend toward effective interfascial plane blocks in laparoscopic cholecystectomy.[19] Chen et al. (2020) similarly reported significantly lower dynamic VAS scores and reduced analgesic consumption in the ESP group compared to TAP blocks, with no difference in nausea or vomiting rates, which resonates with our comparable side effect profiles between groups.[20]

Our results corroborate the growing body of evidence that ultrasound-guided erector spinae plane blocks provide superior postoperative analgesia, lower opioid requirements, and better pain control than oblique subcostal TAP blocks in laparoscopic cholecystectomy. Differences in opioid doses and pain scores reported across studies may be attributed to variations in analgesic protocols, block techniques, and pain assessment methods, but the overall trend strongly favors ESP blocks as an effective component of multimodal postoperative pain management.

This study's strengths include a randomized controlled design and standardized block techniques performed by a single experienced anesthesiologist, which reduce bias. The sample size was adequately powered to detect significant differences in pain outcomes. Postoperative pain was assessed at multiple time points, providing a comprehensive pain profile. However, the study was conducted at a single center, limiting generalizability. The use of subjective pain scores may introduce variability in patient responses. Additionally, long-term outcomes and functional recovery were not evaluated.

CONCLUSION

The ESP block provides superior postoperative analgesia and reduces opioid consumption compared to the OSTAP block in laparoscopic cholecystectomy patients. Both blocks are safe with comparable side effect profiles. ESP block can be considered a preferable option for enhanced pain management in this setting

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