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Ultrasound-Guided Erector Spinae Plane Block versus Oblique Subcostal Transversus Abdominis Plane Block for Post-Operative Analgesia of Adult Patients Undergoing Laparoscopic Cholecystectomy

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ABSTRACT

Objective: To compare the relative effectiveness of Oblique subcostal transversus abdominis plane block with Erector spinae plane block in reliving post-operative pain in patients subjected to elective laparoscopic cholecystectomy.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of Anaesthesiology, Combined Military Hospital, Rawalpindi Pakistan, from Nov 2020 to Apr 2021.

Methodology: Sixty-eight patients were equally divided into two groups, ESP and OSTAP (34 each). ESP-Group received a bilateral erector spinae block, and OSTAP-Group received a bilateral oblique subcostal transversus abdominis block. Ultrasound guidance was used for block execution in both Groups. Bupivacaine 0.375% 20 ml was used for each side of the block. Post-operatively, Acetaminophen 1g IV 8 hourly was given to all patients, and in addition, Tramadol was used as rescue analgesia. Endpoints included comparing total Tramadol usage and Numerical Rating Scale scores between respective Groups.

Results: Post-operative Tramadol consumption in Group-ESP was 144.26±16.38 mg compared with 200.58±17.57 mg of the Group-OSTAP. This difference was significant (p<0.001). Pain scores measured by the Numerical Rating Scale remained lower in the ESP Group throughout the post-operative 24 hours. However, this difference started decreasing after the eighth post-operative hour.

Conclusion: Both the blocks play a good role in multimodal analgesia, but the Ultrasound-guided ESP block reduced post-operative Tramadol consumption and pain scores more effectively than the OSTAP block after laparoscopic cholecystectomy surgery.

Keyword: Erector spinae plane block, Oblique subcostal transversusabdominis plane block, Laparoscopic cholecystectomy.

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INTRODUCTION

Acute post-operative pain can prove devastating, with long-term function and psychological effects if uncontrolled.[1,2] Laparoscopic cholecystectomy (LC), a standard procedure for various gall bladder pathologies, involves minimal surgical intervention. Despite its less invasive nature, it is linked with considerable moderate to severe pain, being the highest in the early post-operative period. Pain arises due to keyhole entries and CO2 insufflation during procedures.[3,4] The most painful site following LC is the umbilical incision site, followed by other trocar sites and the shoulder tip pain.[5] Different therapeutic modalities to attenuate post-operative LC pain have been discussed in the recent literature, including non-steroidal anti-inflammatory drugs, opioids, gabapentinoids, dexamethasone, local anaesthetic port-site infiltration and plane blocks like OSTAP and ESP.[6]

Ultrasound-guided Oblique subcostal transversus abdominis plane block (OSTAP), which is a modification of TAP block, was first explained by Hebbard *et al*.[7] to control post-operative pain mainly after surgeries of the upper abdomen. OSTAP block has been linked with lesser post-operative pain scores and decreases analgesic requirement without causing local anaesthetic toxicity.[8]

Erector spinae plane (ESP) block is a recent block. This involves infiltrating a local anaesthetic agent in the fascial plane next to the erector spinae muscle at the level of the transverse process of the vertebra. It blocks the ventral dorsal and communicates the rami of the spinal cord. ESP block efficiently reduces post-operative pain by reducing the analgesic requirement.[9] However, the studies available about it are fewer. This study looked for the relative analgesic efficacy of OSTAP and ESP block. Our primary endpoint was calculating the total Tramadol usage in two Groups at

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the 24th hour following LC. The secondary endpoint was the comparison of Numerical rating scores (NRS) at different points in time.

METHODOLOGY

The prospective comparative study was conducted at the Department of Anaesthesiology, Combined Military Hospital, Rawalpindi Pakistan, from November 2020 to April 2021. Data collection was started after approval from the Hospital Ethical Committee (111/10/20). The sample size was calculated using the WHO sample size calculator with reference parameter of mean Tramadol usage of 139.1±21.9mg in Group-I and 199.4±27.7mg in the Group-II.[10]

Inclusion Criteria: Patients of either gender aged between 18-70 years, ASA Class I-II, who underwent elective cholecystectomy were included.

Exclusion Criteria: Patients with any coagulation pathology, infection at the location of intervention, body weight of more than 80kg and advanced-stage kidney or liver disease, were excluded.

Patients were counselled, and informed written consent was taken. Using a convenient consecutive sampling technique, a total of 68 patients were included in the study, 34 in each Group. Standard monitoring was used in both Groups. It included non-invasive blood pressure monitoring, pulse oximetry, three-lead electrocardiography and capnography. Temperature measurements were taken as and when required. The induction phase of general anaesthesia was done using a uniform set of drugs in both Groups, including Metoclopramide 0.15mg/kg, Dexamethasone 0.1mg/kg, Nalbuphine 0.1mg/kg, propofol 2mg/kg and atracurium 0.5mg/kg with dose adjusted according to weight, all drugs were given intravenously. Target oxygen saturation was kept at >96%, and end-tidal PC02 between 30-40 mmHg. The maintenance phase included a combination of air and isoflurane in Oxygen (4L/min) with boluses of atracurium 0.1mg/kg as and when required. The degree of neuromuscular blockage was checked with a peripheral nerve stimulator with the train of four (TOF) modality. Intra-operatively, intravenous Ketorolac 0.45mg/kg was given for pain relief. After the surgery, the residual neuromuscular blockage was reversed using Neostigmine 0.04mg/kg and Glycopyrrolate 0.2mg for each 1 mg of Neostigmine.

Both Groups received plane blocks following the induction phase of general anaesthesia but before the start of surgery. Bupivacaine 0.375%, 20ml for each side, was used in both Groups. Patients in the ESP-Group were positioned in the lateral decubitus position and received ESP block. The ultrasound probe (Xario-200) was aligned in the midline at the side of the spinous process of the seventh thoracic spinal vertebra (T-7). After this placement, starting from the midline, the probe was advanced almost 3cm laterally. T-7 transverse process and erector spinae muscle were localized, which were taken as landmarks. After properly sterilizing the intervention site, block needle 80mm 21G (B-Braun medical) was pushed while remaining within the plane till it reached the transverse process. It was introduced at the angle of 30-40 degrees and proceeded cranial to caudal direction. After dissecting the tissue with 2-3 ml of normal saline and confirmation of the needle tip, 20 ml of 0.375% of Bupivacaine was injected deeper into the erector spinae muscle. Then, this process was replicated on the opposite side.

Patients in the OSTAP-Group were given a well-known TAP block with an oblique subcostal approach. Patients were laid supine. The ultrasound probe was placed obliquely near the xiphoid process and then proceeded until the transversus abdominis muscle (TA) became visible. Here, a block needle was inserted, and local anaesthetic was injected when it reached the plane between the TA and Internal oblique muscle. This process was done bilaterally using 20ml of 0.375% Bupivacaine for each side.

At the end of the surgery, patients were shifted to the recovery unit and later to the ward. Intravenous Acetaminophen 1g was given 08 hourly to control pain, and intravenous Tramadol 1mg/kg was given on demand by the patient as rescue analgesia. The total amount of Tramadol administered was calculated at the end of 24 hours for each patient. A numerical rating scale (NRS) scoring system was used to indicate pain assessment in both Groups. A trainee doctor recorded NRS scores at 1st hour, 2nd hour, 8th hour, 12th hour, and 24th hour after the operation.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Independent sample t-test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

Sixty-eight patients were included in the study, 34 in each Group. The dose of rescue analgesia and pain scores were the prime measurements for both Groups

(Table-I). Rescue analgesia, i.e. the usage of Tramadol, remained higher in the OSTAP-Group throughout the 24 hours post-operatively compared to the ESP Group; this difference was statistically significant. The accumulative amount of analgesic used in 24 hours following surgery is summarized in Table-II. Analgesic requirements increased with every successive time window.

ESP-Group showed a lower NRS score post-operatively at the 1st and 2nd hour (*p-value* 0.001 and <0.001, respectively). Although the NRS scores remained low in the ESP Group throughout the observation period, the difference became insignificant after 12 hours post-operatively. This could be due to the increasing rescue analgesic requirement in the OSTAP Group. NRS scores comparison between Groups is shown in Table-III. Three patients underwent hypotension intraoperatively, 02 from the OSTAP Group and 01 from the ESP Group. All were managed successfully. No post-operative complication was noted in either Group.

Table-I: Characteristics of Groups (n=68)

Variables	Erector Spinae Plane Block Group	Oblique Subcostal Transversus Abdominis Plane Block Group	*p*-value
Gender (F/M)	18/16 (52.9%/47.1%)	20/14 (58.8%/41.2%)	-
Age (years)	47.82±12.06	49.88±11.89	0.481
Weight (kg)	70.29± 5.37	68.73±5.44	0.239
American Society of Anesthesiologists physical score status (I/II)	15/19 (44.1%/55.9%)	14/20 (41.2%/58.8%)	-

Table-II: Postoperative Analgesic Requirements (n=68)

Tramadol usage	Erector Spinae Plane Block Group	Oblique Subcostal Transversus Abdominis Plane Block Group	*p*-value
Tramadol usage (1-12hr) mg	56.76±7.67	83.97±12.89	<0.001
Tramadol usage (12-24hr) mg	87.20±13.43	116.61±15.01	<0.001
Total Tramadol used in 24 hr (mg)	144.26±16.38	200.58±17.57	<0.001

Table-III: Postoperative Numerical Rating Scale (NRS) scores (n=68)

Time	Erector Spinae Plane Block Group	Oblique Subcostal Transversus Abdominis Plane Block Group	*p*-value
Postoperative 1st hour	0.91±0.75	1.5±0.89	0.001
Postoperative 2nd hour	1.59±0.82	2.53±0.83	<0.001
Postoperative 8th hour	2.05±0.64	2.41±0.60	0.024
Postoperative 12th hour	2.58±1.04	2.91±0.79	0.156
Postoperative 24th hour	1.23±0.92	1.50±0.50	0.148

DISCUSSION

Pain, which appears as a major concern following laparoscopic cholecystectomy,[11] and one of the major causes of readmission cases,[12] was efficiently controlled by both the blocks as part of a multimodal analgesia regime as supported by Tulgar *et al*.[13] However, the relative efficacy of the two blocks, which was the prime objective of this study, was different. TAP block is a routinely used intervention; usually, it blocks T6-L1 nerve branches, but the field it blocks can vary depending upon the approach used.[14,15]

This study compared the relative analgesic efficacy of ESP and OSTAP block regarding post-operative Tramadol usage and NRS scores. ESP intervention Group showed lesser NRS scores at all points in time. However, this difference started decreasing after the 8th hour post-operatively, which can be explained by the increased use of rescue analgesia in the OSTAP Group. Mean Tramadol usage remained low in the ESP Group. The results of this study regarding rescue analgesia requirement are consistent with the randomized control trial.[16] One study compared the analgesic efficacy of ESP and OSTAP blocks after laparoscopic cholecystectomy. They used Bupivacaine 0.375%. It was concluded that ESP block provides better post-operative analgesia; however, intra-operative fentanyl use was similar between the two Groups.[17] In one study, the difference in NRS scores between the two groups was not clinically significant ($p>0.5$) but was pronounced in terms of post-operative Tramadol usage. It could be because they used a controlled analgesia device which infused 10mg of Tramadol bolus each time.[18]

Similarly, the analgesic superiority of ESP over OSTAP block was shown by Routary *et al*.[19] However, in another study by Ibrahim,[20] it was found that ESP block has no analgesic superiority over OSTAP block

following laparoscopic cholecystectomy as the difference of mean morphine (rescue analgesia) usage between these two groups was statistically insignificant (p=0.173). Likewise, intraoperatively fentanyl usage was similar, but a request for first rescue analgesia was delayed in the ESP block Group by 41±4 min (p=0.001).

Other possible methods to augment analgesia include quadratus lumborum block, paravertebral block at the thoracic level and thoracic epidural. In any case, these methodologies have troublesome and tedious strategies. Hence, they have more dangers of complexities. Thoracic epidural catheterization was linked with longer hospitalization compared to conventional modalities.[21]

CONCLUSION

Both blocks play a good role in multimodal analgesia. However, the Ultrasound-guided ESP block reduced postoperative Tramadol consumption and pain scores more effectively than the OSTAP block after laparoscopic cholecystectomy surgery.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

MA: & BY: Conception, study design, drafting the manuscript, approval of the final version to be published.

SK: & IA: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

HA: & HMT: Critical review, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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