Section A-Research paper
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Comparative study of analgesic effect between erector spinae plane block and transverse abdominis plane block after laparoscopic surgeries

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Abstract:

Background: Various techniques are used for postoperative pain relief after laparoscopic surgeries which includes parenteral analgesics, abdominal nerve blocks, truncal blocks such as the transversus abdominis plane (TAP) block and bilateral erector spinae plane (ESP) block. TAP block has gained popularity as an effective analgesia technique in patients undergoing various abdominal surgical procedures and works by blocking the anterior rami of the spinal nerves of the abdominal anterior wall after spreading of the local anaesthetic agent in the neurofascial plane between the internal oblique and transversus abdominis muscle, thereby relieving the pain. Erector spinae plane (ESP) block is an interfascial plane block given at the paraspinal region and provides effective visceral and somatic analgesia. This study compared the analgesic efficacy of a bilateral erector spinae plane (ESP) block with that of a bilateral transversus abdominis plane (TAP) block after laparoscopic surgeries.

Materials and methods: This study comprised of 60 patients, of ASA grades I– III, between the age group 18 and 60 years, planned for laparoscopic surgeries who were randomly divided into ESP group(n=30) & TAP group(n=30). The ESP group received ESP block at the level of the eighth thoracic transverse process with 15 mL of 0.2% ropivacaine on each side at the end of surgery. The TAP group received an ultrasound-guided TAP block with 15 mL of 0.2% ropivacaine on each side after completion of surgery. VAS score & requirement of first rescue analgesia of each patient was evaluated postoperatively for 12 hours.

Result: The VAS score was significantly less in ESP group at all point of time ($p<0.05$) in the first 12 hours compared to TAP group. Total dose of tramadol used in 12 h was significantly less in group ESP (90±53.6 mg) as compared to group TAP (132±42.7 mg) with $p<0.001$. The time of first analgesic demand was significantly more in group ESP (256±40.1 mins) as compared to TAP group (180±30.5 mins) with $p<0.001$.

Conclusion: The duration of analgesia in group ESP was longer than in group TAP as the time of first rescue analgesic demand is significantly more in group ESP.VAS scores in ESP group was lesser compared to TAP group. Total dose of tramadol used in 12 h was significantly less in group ESP. Hence, we believe that bilateral ultrasound-guided ESP block provides more potent and long postoperative analgesia with less tramadol consumption compared to bi-lateral TAP block after laparoscopic surgeries.

Keywords: Ultrasound-Guided Transversus Abdominis Plane Block, Ultrasound-Guided Erector Spinae Plane Block, Laparoscopic Surgeries

INTRODUCTION

Most surgical procedures produce significant tissue damage together with postoperative complications which results in pain. Adequate pain control management is not only significant in the intraoperative period but also in the immediate postoperative period to prevent long term consequences. Postoperative pain relief is significant because of its effects on hemodynamic parameters and preventing complications in the postoperative period like atelectasis , improper ventilation etc.

Various techniques are used for postoperative pain relief after surgical procedures, including intrathecal and/or systemic opioids, abdominal nerve blocks, truncal blocks such as the transversus abdominis plane (TAP) block with parenteral analgesics and bilateral erector spinae plane (ESP) block. [1,2]

The TAP block consists of injecting local anesthetics between the internal oblique and transversus abdominis muscles to achieve a blockade of the somatic nerves to the skin, muscles and parietal peritoneum of the anterior abdominal wall. This procedure has been shown to provide effective analgesia following a variety of abdominal surgeries. [3]

Erector spinae plane block (ESPB) was first performed and described by Forero "as a successful interfascial plane block for thoracic neuropathic pain" and is now one of the most frequently studied types of plane blocks.[4] It acts by blocking both the dorsal and ventral branches of the thoracic and abdominal spinal nerves; therefore, it provides both somatic and visceral analgesia [5].

The aim of this study was to compare the analgesic efficacy of bilateral ESP block with that of bilateral TAP block after laparoscopic surgeries. The primary study outcome was the duration of analgesia provided by these two types of blocks.

MATERIALS AND METHODS

This study was planned as a prospective, single-blind randomized study. It was conducted in the general surgery operation theatre with postoperative follow-up of up to 12 h in the post-anesthesia care unit as well as in the postoperative wards.

This study comprised 60 patients, of ASA grades I– III, between the age group 18 and 60 years, planned for laparoscopic surgeries. Patients on immunosuppressants, history of substance abuse, allergy to LA or opioids, mental disability & neurological disorders, pre-existing cardiovascular diseases, renal & hepatic disorders, patient refusal & contraindication to regional anesthesia(coagulopathy or localized infection) were not considered for the study;.

A thorough pre anesthetic evaluation was done a day before surgery and all the necessary investigations were done. Tab Alprazolam 0.5 mg and Tab Ranitidine150 mg was given to all patients on the night before the surgery. Patients were maintained nil by mouth for about 8 hrs prior to the surgery. Postoperative pain was assessed by the visual analog
scale (VAS) pain score (range, 0–10; 0, no pain; 10, worst pain)

On the day of surgery, in pre operative room, an appropriate sized iv cannula was inserted. Baseline heart rate, mean arterial pressure were measured. On shifting to operation room, multimodality monitor was connected which included NIBP, Pulse oximeter and Electrocardiogram. Inj Fentanyl 1mcg/kg and Glycopyrrolate 0.2 mg iv were given to all patient 5 minutes prior to the administration of induction agent. All the patients were preoxygenated with 100% oxygen for 5 minutes. All were induced with inj propofol 2-3mg/kg. Succinylcholine 1.5 mg/kg was given before intubation. After the airway was secured, anesthesia was maintained using oxygen and sevoflurane 1–2% and atracurium 0.5mg/kg intravenously. After the completion of surgery TAP & ESP procedures were done on the patients.

Patients were randomly divided into two groups, Group TAP (n=30) and Group ESP (n=30) with the help of computer-generated software. Group TAP was administered subcostal transversus abdominis plane block, using 15 ml of 0.2% ropivacaine on each side. Group ESP group was administered erector spinae plane block at the T8 level on both the sides using the same drug concentration.

All blocks were performed under complete aseptic precaution (under ultrasonographic guidance) using a high frequency linear ultrasound probe. TAP block was performed in supine position. The transducer was placed immediately below the costal margin in the mid axillary line. The external oblique, internal oblique, and transversus abdominis muscles were identified. A 21-gauge 8-cm needle was introduced using an in-plane approach, 2–3 cm lateral to the transducer from medial to the lateral direction to reach the TAP between the internal oblique and transversus abdominis muscles. After confirming the correct placement of the needle, the local anesthetic drug (15 ml 0.2% ropivacaine on each side) was injected in the transversus abdominis plane. The block was performed bilaterally.

ESP block was performed in lateral position and the transducer was placed in a longitudinal parasagittal orientation 3-cm lateral to the T8 spinous process. The erector spinae muscle was identified superficial to the tip of the T8 transverse process. An 21-gauge 8-cm needle was inserted using an in-plane superior to inferior approach to place the tip into the fascial plane on the deep (anterior) aspect of the erector spinae muscle and the local anesthetic drug (15 ml 0.2% ropivacaine on each side) was injected. The location of the needle tip was confirmed by visible fluid spread lifting the erector spinae muscle off the bony shadow of the transverse process. The procedure was repeated on the other side.

After completing the block procedure, the neuromuscular block was reversed with neostigmine 0.05 mg/kg and glycopyrrolate 0.005mg/kg intravenously followed by extubation of the patient. Patient was shifted to the postoperative recovery room.

The visual analog scale (VAS) pain score was recorded from the 15th minute in the recovery room followed-up by 30 mins, subsequently 1 ,2 , 3, 4 h up to 12 h postoperatively. Intravenous tramadol 50mg as rescue analgesia was administered in patients with a VAS score of 3 and over, while intramuscular diclofenac 1mg/kg was considered for patients with VAS score of 6 and above in the postoperative period along with tramadol. In 12 h, the time of administration of first rescue analgesic given was noted. Postoperative vitals were documented.

Patients were also observed for complications such as local hematoma, subcutaneous emphysema, pneumothorax, signs of local anesthetic toxicity, signs of visceral or peritoneal injury, or motor weakness.

Statistical Analysis

In the present study the collected data were analyzed with IBM.SPSS statistics software 23.0 Version. The results are given as Mean ± Standard Deviation and Range values for continuous data. Student's t-test was used to compare the two groups. Categorical data are expressed as number & percentage and difference between the groups was compared by chi-square test. A p value of 0.05 or less was set for statistical significance.

RESULTS

Table 1 Demographic Characteristics and ASA Grades

	Group TAP	Group ESP	P value
Age in years (mean ± SD)	46±14.2	46±12.2	0.99
M/F	10/20	12/18	0.45
Weight(kgs)	70.9±8.85	70.7±7.36	0.93
Height (cms)	162.68±5.69	165±5.20	0.34
ASA grade I/II/III	5/17/8	4/19/7	0.98

No significant difference in demographic distribution between both the groups.

Table 2 Hemodynamic parameters of the two groups

	Group TAP (mean ± SD)	Group ESP (mean ± SD)	P value
Mean HR (beats/min)	87±8.38	86±8.07	0.29
Mean SBP (mmHg)	133±13.8	131±13.9	0.09
Mean DBP (mmHg)	84±8.8	83±8.9	0.09
Mean MAP(mmHg)	98±8	94±7	0.04

No significant difference in hemodynamic parameters between both the groups.

Table 3 Rescue analgesic requirements of the two groups

	Group TAP	Group ESP	P value
Total tramadol consumption per patient in 12 h (mg) (mean ± SD)	132±42.7	90±53.6	0.001

Total dose of tramadol used in 12 h was significantly less in group ESP as compared to group TAP.

Table 4 Comparison of 1st rescue analgesic time

	Group TAP	Group ESP	P value
1st rescue analgesic time in mins	180±30.5	256±40.1	<0.001

The time of first analgesic demand is significantly more in group ESP as compared to TAP group.

Table 5: Mean VAS pain score in first 12 hours of postoperative period.

Time	Mean value of VAS		P value Mean value of VAS
	TAP	ESP	
15 mins	3.33	1.65	0.033
30 mins	3.78	1.23	<0.001
1st hour	3.38	0.95	<0.001
2nd hour	1.85	0.38	<0.001
3rd hour	1.93	0.65	<0.001
4th hour	3.29	0.88	<0.001
5th hour	1.75	0.88	0.005
6th hour	1.73	0.25	<0.001
8th hour	1.29	0.19	<0.001
10th hour	1.13	0.23	<0.001
12th hour	1.15	0.15	<0.001

The VAS pain score was assessed for first 12 hours. None of the patients complained of severe pain (VAS>7). Table 5 show the comparison of VAS score between the two groups. The VAS score was significantly less in ESP group at all point of time ($p<0.05$) in the first 12 hours.

DISCUSSION

Regional blocks are commonly used for postoperative pain management in various anterior and posterior abdominal surgeries. With the introduction of ultrasonogram in anesthetic practice, the regional blocks have gained more popularity with the advantage of real view imaging and lesser failure and toxicity rates. Good postoperative analgesia is an important component of adequate perioperative care. Regional nerve blocks are associated with improved perioperative outcomes, reduction in perioperative stress, improved patient satisfaction, coupled with reduction in opioid consumption, fewer adverse effects and lesser requirement of rescue analgesia following elective abdominal surgeries.

Routinely practiced regional blocks for Laparoscopic surgeries include TAP, ESP and rectus sheath block. [6] 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. [7] 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. [7-8] However, LA spread following ESP block is conflicting and other studies have shown unpredictable dye spread. [9]

In a similar study done by Tulgar S et al., which compared the effect of ESP block with TAP block and control group in Laproscopic cholecystectomy patients. [10] 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 12 hours opioids requirement as well as mean VAS score over 12 hours..

Hamed et al found that the analgesic effect of an ESP block lasted for 12 hours in women undergoing abdominal hysterectomy.[11]

Yamak et al documented prolonged analgesia in a patient undergoing lower abdominal cesarean section after bilateral ESP block using a single injection and reported numeric rating scale scores of 1–3 in the first 24 hours.[12]

Altıparmak B. compared the efficacy of ESP and TAP in Lap cholecystectomy patients. [13] They used 20 mL of 0.375% bupivacaine as local anesthetic drug 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 TAP group. Various other studies also found that ESP block had higher analgesic efficacy & lesser requirement of opioid consumption compared to TAP block [14]

In the study conducted by Malawat (Malawat et al. 2020), comparing ESPB and TAP block in cesarean section patients using 0.2% ropivacaine, they found that the first rescue analgesic was given at a mean of 43.53 h in the ESPB group, compared to 12.07 h in the TAP group.[15]

However, in our study, ESP block showed better analgesic efficacy compared to TAP block. The VAS score was significantly less in ESP group at all point of time ($p<0.05$) in the first 12 hours compared to TAP group. Total dose of tramadol used in 12 h was significantly less in group ESP (90±53.6 mg) as compared to group TAP (132±42.7 mg). The time of first analgesic demand is significantly more in group ESP (256±40.1 mins) as compared to TAP group (180±30.5 mins).

The main limitation of the study was extent of sensory blockade and assessment of pain beyond 12 hours was not evaluated.

CONCLUSION

The duration of analgesia in group ESP was longer than in group TAP as the time of first rescue analgesic is significantly more in group ESP. Total dose of tramadol used in 12 h was significantly less in group ESP as compared to group TAP. Hence, we believe that bilateral ultrasound-guided ESP block provides more potent and longer postoperative analgesia with less tramadol consumption compared to bilateral TAP block after laparoscopic surgeries.

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