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Comparison of analgesic efficacy of two different techniques of ultrasound guided blocks for postoperative pain relief in Laparoscopic surgery

Dr Chitralekha Patra[1], Dr Jagannath Panda[2], Dr Minati Mohapatra[3], Dr Chandra Sekhar Behera[4], Dr Ranjita Baksi[5],Dr Nibedita Sahu[6]

[1]Associate Professor, Department of Anaesthesiology, Shri Jagannath Medical College and Hospital,Puri

[2]Assistant Professor, Department of Anaesthesiology, Shri Jagannath Medical College and Hospital, Puri

[3]Associate Professor, Department of Physiology, F M Medical College and Hospital, Balasore

[4]Associate Professor Department of Anaesthesiology, S.C.B. Medical College, Cuttack

[5,6]Assistant Prof. Department of Anaesthesiology, S.C.B Medical College & Hospital, Cuttack

Corresponding author-Dr Chandra Sekhar Behera,

Abstract

Background : Laparoscopic surgery can induce moderate postoperative pain due to small keyholes on the abdominal wall. The oblique subcostal transversus abdominis plane block(OSTAP)has been used for postoperative pain management after abdominal surgery but found ineffective. **Aim:** Our aim is to compare the efficacy of erector spinae block with OSTAP block for postoperative pain management after laparoscopic surgery. **Material &Methods:** Ninety patients, posted for laparoscopic surgery were divided into three equal groups of 30 each. Erector spinae plane block was given in the ESP group. Oblique subcostal transversus abdominis plane block was given in the OSTAP group and IV analgesics were administered in control group for postoperative pain management. Postoperative rescue analgesic (paracetamol) consumption,time to 1st rescue analgesia request, numerical rating score (NRS), and any complications in 1st 24 hrs between the three groups were recorded and analyzed. Statistical Package for the Social Sciences version 21.0 was applied for statistical analysis. Descriptive statistics were expressed as mean ± standard deviation.**Result:**Postoperative rescue analgesia (paracetamol) consumption was 2.2± 0.77gm in ESP group , 2.91 ±0.19gm in OSTAP group and 4.17± 0.66gm in control group which was statistically significant. Time to 1st rescue analgesia request was 374.16±30.56 mins in ESP group, 294.62±43.19 mins in OSTAP group and 152.6± 37.45mins in control group which was statistically significant. **Conclusion:**Ultrasound

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guided ESP block is more effective in postoperative pain management after laparoscopic surgery when compared to OSTAP group and control group.

Keywords- laparoscopy, postoperative pain management, erector spinae plane block.oblique subcostal transversus abdominis plane block

Introduction

Laparoscopic surgery is one of the most common minimally invasive surgery performed through small keyholes on abdominal wall. Laparoscopic surgery can cause moderate to severe postoperative pain which have several components like incisional pain from the trocar site (somatic pain) and deep abdominal pain(visceral pain).[1] Multimodal approaches including opioids, nonsteroidal anti-inflammatory drugs, dexamethasone, gabapentinoids, local anesthetic infiltration to port sites, epidural analgesia and transversus abdominis plane block(TAP) have been used to alleviate postoperative pain after Laparoscopic surgery.[2] Hebbard et al [3] first described the subcostal approach of TAP block for postoperative pain management in upper abdominal surgeries. Few studies have reported that ultrasound guided oblique subcostal transversus abdominis plane (OSTAP) blocks reduced postoperative pain scores and opioid consumption in the first 24 hrs after Laparoscopic surgery but it is not effective in reliving visceral pain. Forero et al [4] first described the ultrasound guided ESP block which target the ventral rami, dorsal rami, and rami communicantes of the spinal nerves,so it is more effective against both somatic and visceral pain. Also, spread of local anaesthetic agent extends both cranially and caudally over several dermatomal levels producing better analgesia. Few studies have found that ESP block can provide postoperative analgesia after different abdominal surgeries.[5]The present study was done to evaluate the analgesic efficacy of ultrasound guided ESP block and OSTAP block after laparoscopic surgery. Our primary aim was to compare the total rescue analgesia consumption at the postoperative 24th hour between the three groups. The secondary aims were time of 1st rescue analgesia request, NRS score at different time points, and any complications in 1st 24 hrs.

Material &Methods

This is a prospective, randomized controlled study conducted at a tertiary care hospital in Odisha after approval of institutional ethical committee between September 2022 and October 2023. All patients involved had given written informed consent for inclusion into this study.

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Patients aged 20-60 years with an American Society of Anaesthesiologists (ASA) physical status classes of I and II who were scheduled to undergo various elective Laparoscopic surgery were included in this study.

Exclusion criteria

- Patients who refused enrolment
- Known allergy to local anesthetic
- Those with bleeding diathesis
- BMI>30kg/m^2
- Infection at the site of needle puncture

The patients were divided into three groups, two groups received either ultrasound guided ESP block or OSTAP block and third group or control group received our institute's standard analgesia plan with no block. Randomization was performed according to a computer-generated sequence of random number and allocation allotments were stored in sealed opaque envelopes to be opened prior to block procedures.

Standard monitoring procedures included pulse oximetry, electrocardiography, bispectral index and noninvasive arterial pressure. Ringers'lactate (15ml/kg) was started after putting a 20 G iv cannula. All patients were premedicated with intravenous (i.v.) midazolam 0.04 mg/kg and fentanyl 2mcg/kg. USG guided blocks were performed. For all blocks, a GE Logiq F™ (General Electric Healthcare, Little Chalfont, United Kingdom) ultrasound with a high frequency (6–15 MHz) 38mm L6–12 linear probe and a Stimuplex® A 50mm (B Braun HNS 11-12218, Stockert GmbH, BotzingerStrabe72, D-79111 Freiburg, Germany) were used. LA mixture included 20 mL of bupivacaine 0.375%, was injected on each side. Induction was performed using propofol 2–3 mg/kg and vecuronium bromide 0.01 mg/kg and maintained with 0.6 minimum alveolar concentration sevoflurane with target BIS 40-60. Pneumoperitoneum was evacuated in all patients at the end of surgery. Then patients were extubated and transferred to the post anesthesia care unit(PACU).Follow up in PACU was performed by anesthesiologist who were blinded to the groups.

Erector spinae plane block

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ESP block was given in left lateral position in the out of plane approach using a high frequency linear transducer. The transducer was put longitudinally 2.5–3 cm lateral to the T9 spinous process. The tip of the T9 transverse processes was located and superficial to it the erector spinae muscles were identified. A 21G 10cm needle (B.Braun) was inserted into the fascial plane on the anterior aspect of the erector spinae muscle. The position needle tip was confirmed by visible fluid spread lifting the erector spinae muscle off the bony shadow of the transverse process of T9 and 20 mL of bupivacaine 0.375% was injected. Due to reports that ESP blocks visceral pain and as at least one trocar is placed in the midline, the same procedure was repeated for the opposite side.

Oblique subcostal transversusabdominis plane block

OSTAP block was performed in the supine position with the in plane approach using a high frequency linear transducer. The transducer was put immediately below the costal margin obliquely and rectus abdominis, transverse abdominis, internal oblique and external oblique muscles were identified. A 21G 10cm needle (B.Braun) was inserted using an inplane approach from medially to laterally and 20 mL of bupivacaine 0.375% was injected between the fascia immediately above the rectus abdominis muscle.

Postoperative pain was assessed using the numerical rating score (NRS). The NRS is a segmented numeric version of the Visual Analog Scale (VAS)in which a respondent selects a whole number (0–10) that best reflects the intensity of his/her pain.The11‑point numeric rating scale ranges from 0 representing no pain to 10 representing extreme pain. Changes in NRS at rest and on movement were recorded at different time intervals. During the 1st 24 hr postoperative period, Paracetamol 1gm was given if Numeric Rating Scale score (NRS)>4. Total consumption of paracetamol in 1st 24 hrs and time to 1st rescue analgesia was measured in all groups.

NRS pain scores was recorded postoperatively at the 20th min, 40th min,1st, 3rd, 6th, 9th, 12th , 15th, 18th, 21st and 24th hr both at rest and when coughing. Shoulder pain during the first 24 hr and presence of postoperative nausea and vomiting were noted. Postoperative nausea was assessed by patients on a 4point scale (0- none, 1- mild, 2- moderate, and 3- severe). Sample size was calculated based on a pilot study with 10 patients in each group. 20% reduction in consumption of rescue analgesia in postoperative 24 hr was considered to be clinically significant. The mean paracetamol consumption in ESP block group was 1.7± 0.23 gm, in

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OSTAP block group was 2.65± 0.12gm and in control group it was 3.9±0.94gm. Using power of 0.90 and significance level of 0.05.minimum sample size was calculated to be 26 patients for each group. Considering the possibility of dropouts, we decided to include 30 patients for each group.

Statistical Package for the Social Sciences version 16.0 statistical package program (SPSS Inc., Chicago, IL, USA) was applied for statistical analysis. Descriptive statistics were expressed as mean ± standard deviation. For univariate analysis of means between the groups a 2 sample, independent t-test assuming equal variances were used. For data without normal distribution, Mann–Whitney U test was used. Ratios were compared using Chisquare test and Categorical variables were compared using Fisher's exact test. Continuous variable was tested for normality via the Shapiro–Wilk test. P values < 0.05 was considered statistically significant.

Results

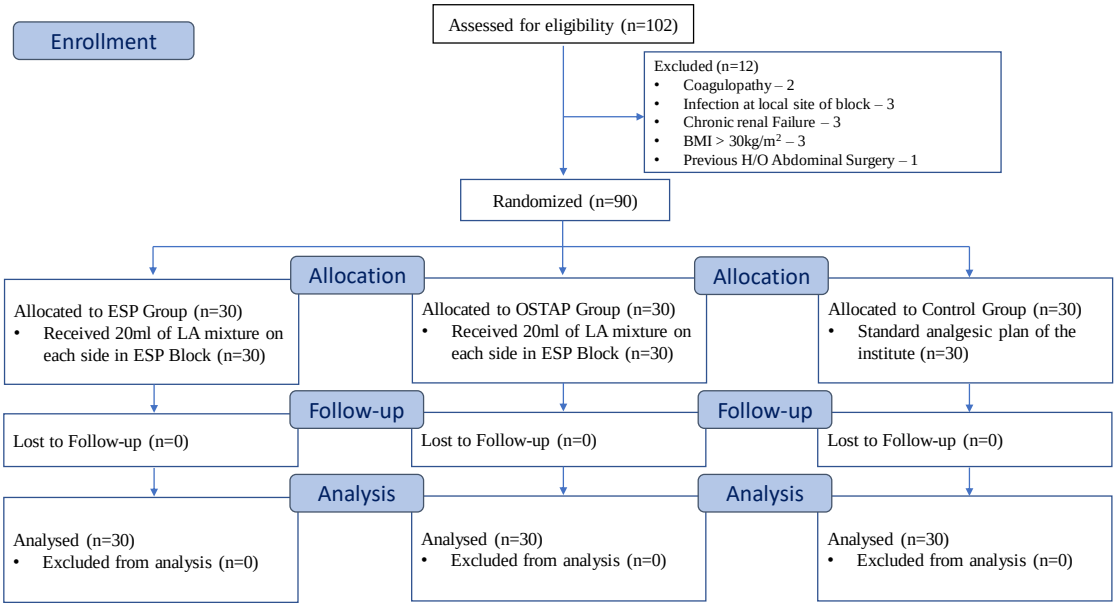

Figure-1: Flow chart

Hundred and two patients scheduled to undergo Laparoscopic surgery were evaluated for inclusion in this study. Two patients for coagulopathy, three for infection at block site, three for chronic renal failure, three for BMI>30kg/m^2 and one patient with history of abdominal surgery

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were excluded from the study. 90 patients were included in the study and all completed the study.

Table 1: Descriptive variables of groups.

Variables	Group ESP (n=30)	Group OSTAP (n=30)	Group Control (n=30)	P value (esp vs ostap)	P value
Age(years)	51.40±12.17	53.12±12.83	52.35±12.34	0.765	0.743
Female	19	18	19	0.311	0.418
Male	11	12	11		
ASA I	21	15	18	0.589	0.454
ASA II	9	15	12		
Surgical Time (mins)	49.11±9.31	54.22±8.49	50.23±7.96	0.434	0.357
Block Performing Time (mins)	9.34±1.88	9.85±1.25	NIL	0.154	0.421
BMI (kg/m^2)	25.22±5.16	26.15±5.19	27.12±5.28	0.135	0.253

There was no statistically significant difference between the three groups regarding the descriptive variables.(table 1)The p value between ESP and OSTAP groups have been calculated using unpaired t test and between all the three groups have been calculated using ANOVA test

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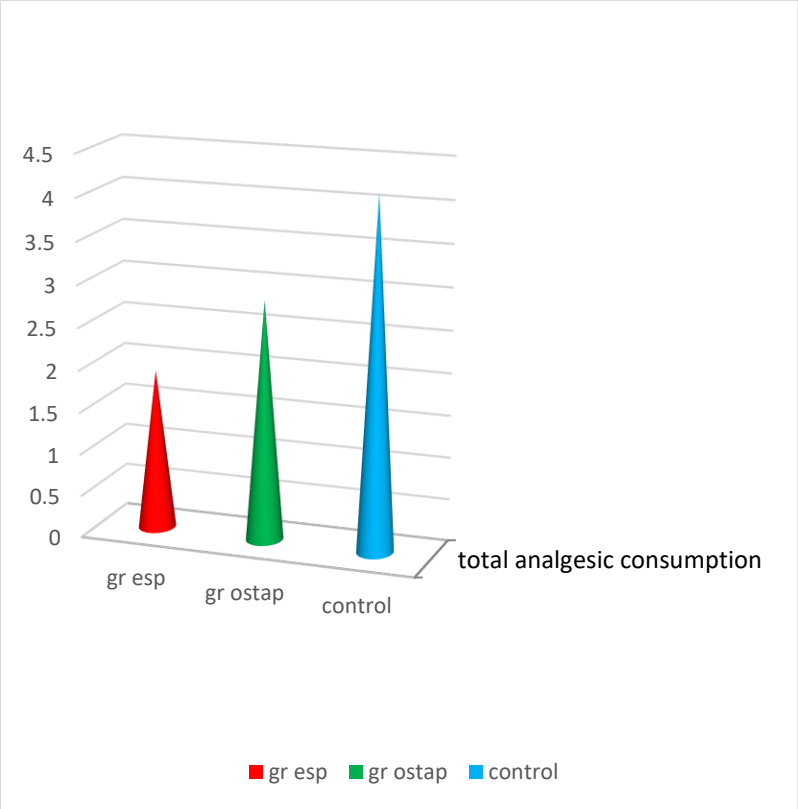

Figure-1: Total analgesic consumption in 24 hrs

Figure 1 shows total analgesic consumption(paracetamol in gm) in all the three groups. Postoperative rescue analgesia (paracetamol) consumption was 2.2± 0.77gm in ESP group, 2.91 ±0.19gm in OSTAP group and 4.17± 0.66gm in control group which was statistically significant.

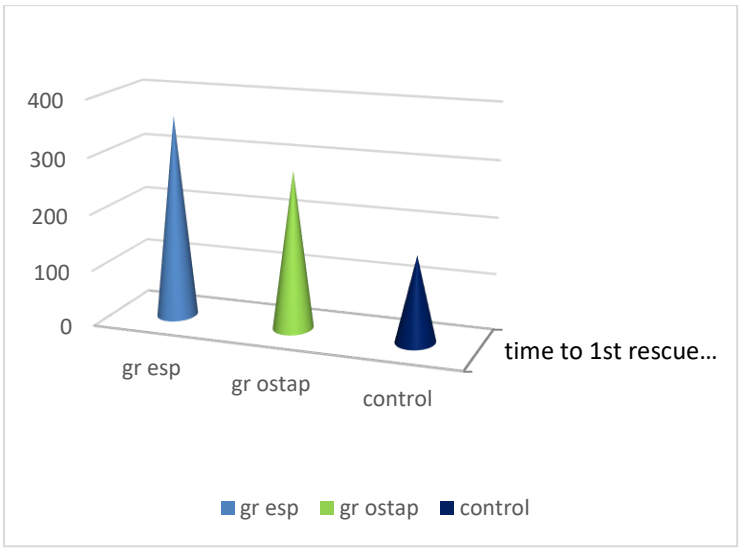

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Figure 2- Time to first analgesia request

Figure 2 shows time to first rescue analgesia (mins) in all the three groups. Time to 1st rescue analgesia request was 374.16±30.56 mins in ESP group, 294.62±43.19 mins in OSTAP group and 152.6± 37.45mins in control group which was statistically significant.

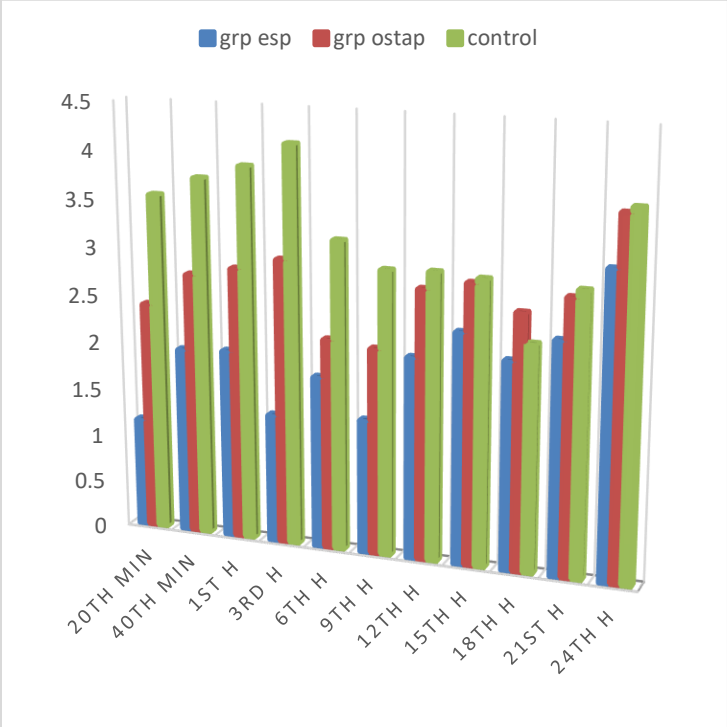

Figure-3: Evaluation of Numeric Rating Scale scores at rest

Figure 3 shows numeric rating scale (NRS) at rest in all the three groups.In 1ST 6hrs NRS score at rest was lower in ESP group than OSTAP group which was statistically significant($p<0.05$). After 6 hrs NRS score was comparable in both block groups.On the other hand NRS score was higher than both block groups in the control group and was comparable after 6 hrs.

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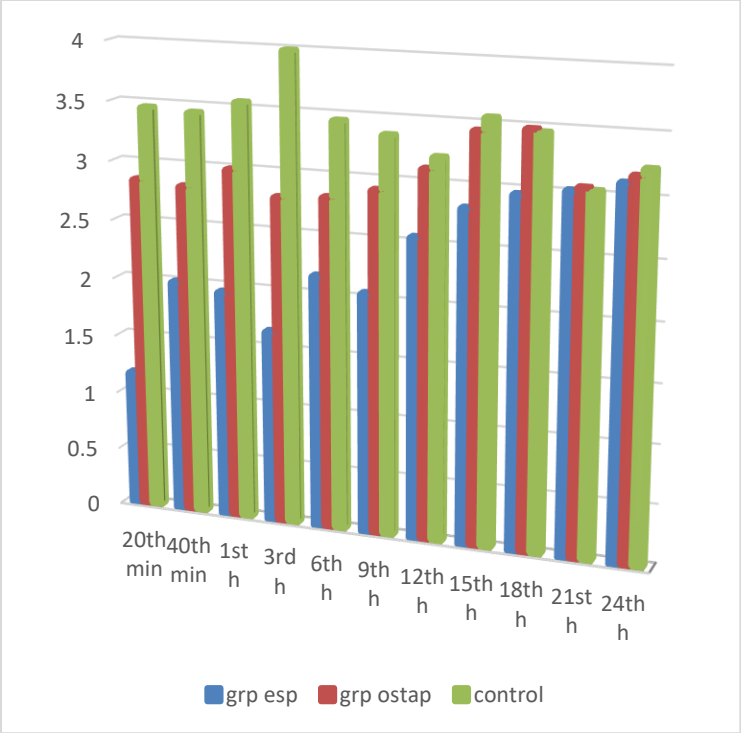

Figure-4: Evaluation of Numeric Rating Scale scores during coughing/movement

Figure4 shows numeric rating scale (NRS) on coughing / movement in all the three groups.In 1ST 6hrs NRS score on coughing/movement was lower in ESP group than OSTAP group which was statistically significant($p<0.05$). After 6 hrs NRS score was comparable in both block groups.On the other hand NRS score was higher than both block groups in the control group and was comparable after 9 hrs.

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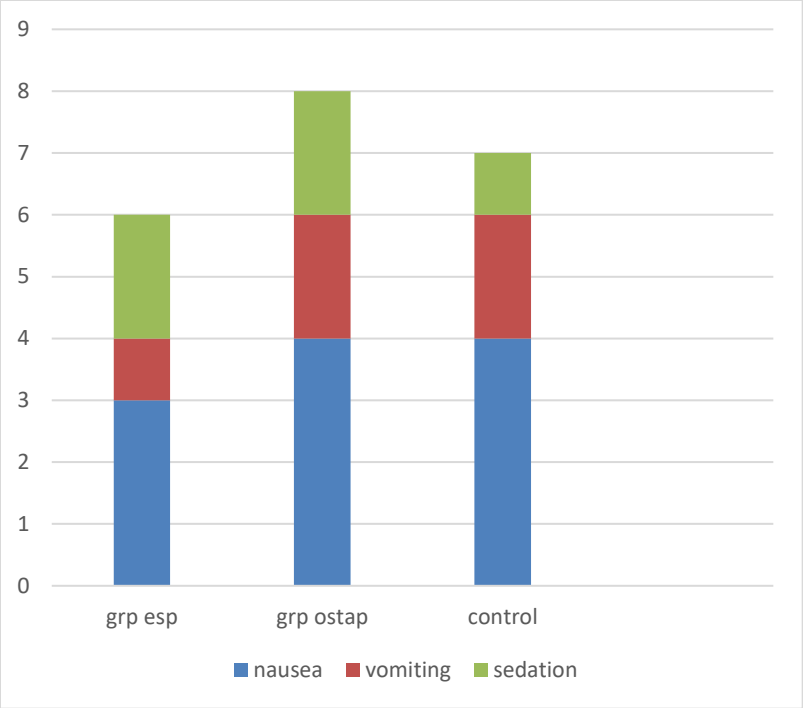

Figure-5: Incidence of PONV and sedation

Figure 5 shows different complications (nausea, vomiting, sedation) between all the three groups.No patient had right shoulder pain in either study group. There was no statistical difference ($p > 0.05$)in complications in all groups.4 patients in ESP group and 6 patients in OSTAP group had nausea and vomiting which was not statistically significant.2 patients in group esp and group ostap developed sedation whereas 1 patient in control group developed sedation.

Discussion

In our study, rescue analgesic (Paracetamol) consumption was significantly lower in the ESP group at 24 hr postoperatively compared to OSTAP and control group. Time to 1st rescue analgesia was increased in ESP group compared to OSTAP group and control group which was statistically significant. NRS scores at rest and after coughing were significantly less in the ESP group compared to OSTAP and control group. The control group showed a significantly higher analgesic requirement and higher NRS scores both at rest and with coughing with a lesser time to 1st rescue analgesia when compared to both block groups. There was no significant difference between the groups in postoperative complications. Acute pain following Laparoscopic surgery has several components like incisional pain from the trocar site, local visceral pain, parietal pain,

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and referred shoulder pain.Bisgaard et al [5] reported that parietal pain due to a skin incision contributed more to postoperative pain than other components. Recent studies evaluated the effect of OSTAP block for post-operative analgesia after Laparoscopic surgery.Studies have reported that OSTAP block produced analgesia for somatic pain and parietal pain of almost the entire anterior abdomen and effectively reduced postoperative pain. Oksar et al.[6] studied the effects of intercostal-iliac TAP block, OSTAP block, and intravenous multimodal analgesia after Laparoscopic surgery. They found that OSTAP block was highly efficient in reducing postoperative pain scores compared to other methods. Basaran et al[7] reported that OSTAP block successfully decreased postoperative pain after Laparoscopic surgery. Ramkiran et al [8] compared the effectiveness of a rectus sheath block-OSTAP block combination, OSTAP block alone, and conventional port site infiltration for postoperative pain. They reported that in the combination group, pain scores were significantly low at the second postoperative hour. Also, opioid consumption in the postoperative 24 h was significantly low in the combination group. Inspite of successful outcomes of many studies, the patchy pattern of sensory block over the lateral and posterior abdominal walls may induce discomfort with OSTAP block after Laparoscopic surgery. Although OSTAP block have effect on somatic and parietal components of postoperative pain after Laparoscopic surgery, it has no effect on visceral component, so it may cause inadequate analgesia in some patients. Thus, multimodal analgesic technique with an alternative approach to alleviate postoperative visceral pain after Laparoscopic surgery may be required. Ultrasound guided ESP block can produce blockage of both visceral and somatic nerve fibers making it excellent choice for postoperative analgesia.[9]ESP block can block the rami communicantes that transmit fibers to and from the sympathetic ganglia. Few studies are there in literature which shows the efficacy of ESP block for postoperative pain management after Laparoscopic surgery.[10,11] Tulgar et al [12] described multimodal analgesia protocols in three patients who had endoscopic retrograde cholangiopancreatography, followed by Laparoscopic surgery. They performed ultrasound guided ESP block at the level of T8 with 10 ml of 0.5% bupivacaine, 5 ml of 2% Lidocaine and 5 ml of isotonic saline following anesthesia induction. They reported that in an ambulatory surgical setting, the NRS scores of the patients were under 3/10. Tulgar et al. [13] assessed the effect of ultrasound guided ESP block on postoperative pain scores and analgesic consumption after Laparoscopic surgery. In their study, they increased the bupivacaine concentration to 0.375% due to block failure and insufficient

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sensorial block. Aksu et al [14] described the cases of three pediatric patients who received ESP block for pain management after Laparoscopic surgery. They performed ESP blocks at the level of T7 with0.5 ml/.kg of 0.25% bupivacaine and found that none of the patients required rescue analgesia in the first postoperative 48 hours. They concluded that bilateral ESP block provides effective analgesia in pediatric Laparoscopic surgery. Altiparmak et al [15] concluded that ESP block reduced the postoperative opioid consumption, pain scores, and intra operative fentanyl requirement more effectively than OSTAP block after Laparoscopic surgery. The ideal concentration of local anesthesia for ESP block in thoracic and abdominal surgeries was yet to be determined. In a study by Kashani et al [16] 3.6 ml of local anaesthetic per vertebral level was reported to be adequate in ESP block.However, spread of local anesthesia at different thoracic or lumbar vertebral levels may differ. So local anesthesia volume and concentration may vary according to patients' age and type of surgery to be performed. Few studies have reported that, 20 ml of local anesthesia applied at T4 has been shown to spread caudal and cephalad for three to seven vertebral levels.[17,18] Though ideal concentration of local anesthetic for ESP block has yet to be decided,we in our study used 20 mL 0.375% bupivacaine. Vidal et al[19] in a cadaveric study concluded that ESP block produced epidural, neural foraminal, and intercostal spread of local anesthetic. This extensive spread of local anesthetic agent may be more over a larger dermatomal area than the OSTAP block. So ultrasound guided ESP block can be performed simply and quickly with easily identified ultrasound guided landmarks and this can provide prolonged analgesia with less risk when compared with any other regional block techniques.

Conclusion

Ultrasound guided Erector spinae plane (ESP) block decreased consumption of analgesic in first 24 hr and delayed the time of 1st analgesia request compared to OSTAP block in laparoscopic surgery.

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