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Thoracic Epidural versus Surgically placed Rectus Sheath Catheters for Postoperative Analgesia after Midline Laparotomies: A Randomized clinical Trial

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ABSTRACT

Background: Midline laparotomies are accompanied by severe postoperative pain that is mainly related to abdominal wall incision. **Objective:** This study aimed to find if the analgesia provided through rectus sheath catheters can be safe and effective as thoracic epidural analgesia for early postoperative pain relief after midline laparotomies.

Patients and Method: 50 patients were randomly allocated into 2 groups: **Group TEA** (n=25): on wound closure 20 mL of 0.25% bupivacaine + 40 μg fentanyl were injected into epidural catheter. Thereafter, every 6 h, 20 mL 0.125% bupivacaine + 40 μg Fentanyl for 48 h were injected into the catheter. **Group RSB** (n=25): bilateral rectus sheaths catheters were surgically placed during wound closure. On each side, 20 mL bupivacaine 0.125% + 20 μg fentanyl were injected. Then, every 6 h, 10 mL 0.125% bupivacaine + 20 μg fentanyl were given through each catheter for 48 h. **In both groups**, IV 1 gm paracetamol/8h was given. If visual analogue scale (VAS) score became ≥ 4. Also, IV fentanyl was given. **Results:** intraoperative and postoperative fentanyl consumption, time to first analgesia, VAS and sedation levels were comparable between groups. Time for first oral intake was shorter in group TEA. Time for independent ambulation was shorter in group RSB. Post-operative nausea and vomiting (PONV) and pruritus were higher in group TEA. Patients' satisfaction was higher in group RSB.

Conclusion: Analgesia through surgically placed rectus sheath catheters is a safe and effective alternative to thoracic epidural analgesia in midline laparotomies. Clinical trials registration number: NCT04262622.

Keywords: Thoracic epidural analgesia, Rectus sheath block.

INTRODUCTION

Adequate post-operative analgesia after midline laparotomies through multimodal interventions reduces complications (e.g. chest infection or deep venous thrombosis) and leads to rapid recovery and early mobilization, better patients' satisfaction, and less hospital stay [(1)].The standard technique for post-operative analgesia after major abdominal surgery is thoracic epidural analgesia (TEA) [(2)]. Postoperative ileus is a serious complication and can be defined as decreased motility of the gastrointestinal tract (GIT) after abdominal or non-abdominal surgeries in the absence of mechanical cause for GIT obstruction [(3)]. Its incidence has been reduced with TEA when compared to systemic opioids for postoperative analgesia in major abdominal surgeries and was explained by the sympathetic block during TEA [(4)]. On the other hand, the complications encountered with TEA motivates the search for another technique, besides that in some situations, midline incision is a need while TEA is contraindicated e.g. emergency laparotomy. Complications of TEA might be a high failure rate (up to 30%) [(2)], hypotension is common and may be accompanied by iatrogenic fluid overload [(5)], and motor block of the lower limbs with resultant delayed post-operative mobilization [(6)]. Rarely (although serious), complications as nerve injury or epidural hematoma with or without paraplegia or epidural abscess might occur [(7)].

Rectus sheath nerve block (RSB) [(8)] (blocking anterior division of the 7^{th} to 11^{th} intercostal nerves supplying the rectus abdominis muscle and its overlying skin) was first described by the end of the last century without so much attention payed to the technique [(9)]. The growing attention nowadays was attributed to the availability of new local anesthetic agents, small-caliber catheters with or without ultrasound guidance [(10)]. RSB is a regional anesthetic technique that provides midline somatic analgesia from xiphoid process to symphysis pubis with no visceral analgesia. Thereby, systemic analgesics are required [(9)]. Rectus sheath analgesia (RSA) can be achieved by injecting local anesthetic through the inserted catheter with or without adjuvants into the potential space between the rectus muscle and the posterior rectus sheath either as intermittent doses every 6-12 hours, or by continuous infusion of local anesthetic during the early postoperative period (12-36 h) [(9)]. It was hypothesized that rectus sheath analgesia (RSA) might be an alternative to thoracic epidural analgesia. Thereby, the aim of the current study was to find whether analgesia provided through surgically placed rectus sheath catheters can be a safe and effective alternative to thoracic epidural analgesia for early postoperative pain relief in patients undergoing elective abdominal surgery through midline incision.

PATIENTS AND METHODS

This prospective randomized study was conducted on 50 adult patients (of 21-65 years), American Society of Anesthesiology (ASA) physical status classification of I – III [(11)], with body mass index (BMI) of 18.5–29.9 kg/m^2, of both sexes, who were posted for elective abdominal operations with midline incision under general anesthesia (e.g. colorectal resections including right or left hemicolectomy or segmental colonic resection). The study was conducted at Zagazig University Hospitals during the period from June 2019 to February 2021.

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Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee (IRB number: ZU-IRB #5902-22-5-2019). Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Exclusion criteria: Extensive surgery beyond midline incision (e.g. abdomino-perineal resection), refusal of the patients, coagulopathies, local infection at sites of catheters insertion, systemic sepsis, severe cardiac or respiratory disease, severe renal or hepatic impairment, allergy to drugs used in the study and known substance abuse.

All patients were premedicated with midazolam 0.07 to 0.08 mg/kg IM once, up to 1 hour before surgery. Thirty minutes before surgery IV ranitidine hydrochloride (Zantac) 50 mg (2 mL) in 0.9% sodium chloride diluted to 20 mL were given slowly over a duration of 5 min.

Patients were randomly allocated using computer generated randomization tables into two groups:

- ***Thoracic epidural analgesia group*** (Group TEA n=25): In this group TEA was performed by the insertion of transthoracic epidural catheter before induction of general anesthesia under complete aseptic conditions with the patient in the sitting position and neck and upper back flexed. The skin and subcutaneous tissues was infiltrated using 1 mL lidocaine 2% approximately lateral to the inferior aspect of the targeted spinous process using a 1.5-inch 25-gauge needle. A 17-gauge Tuohy needle was introduced through paramedian approach and ensuring the correct placement into the epidural space was done using hanging drop technique. For all patients in this group, the needle was introduced at T7 to T9. A test dose of 3 mL of lidocaine 2% with 1:200,000 adrenaline was injected through the epidural catheter followed by induction of general anesthesia. On wound closure 20 mL 0.25% bupivacaine + 40 μg fentanyl were injected into the epidural catheter. Thereafter, in post-anesthesia care unit (PACU) and in surgical intensive care unit (SICU), 20 mL of 0.125% bupivacaine + 40 μg fentanyl were administered every 6 h for 48 h (the safe dose of bupivacaine is 2 mg/kg every 6 hours) [(8)].
- ***Rectus sheath block group*** (Group RSB n=25): Two sets of epidural catheters, which have multiple perforations at the end of the tubing (Perifix 402 filter set, 16 G epidural needle, B. Braun Melsungen AG. 34209 Melsungen, Germany) were needed for each patient in this group. By the end of surgery, the surgeon placed the catheter under vision. Touhy needle was inserted 2-4 cm lateral to the midline in an angle of 45 degrees to the skin, through the anterior abdominal wall until reaching the potential space between the posterior layer of the rectus sheath and rectus abdominis muscle (**Figure 1**). **Figure (2)** showed the steps of surgical insertion of the catheter into the rectus sheath. The surgeon put the non-dominant hand inside the abdomen to locate the needle tip and the other hand gently pushed the non-traumatic epidural needle in the interface between the peritoneum and muscle layer. The catheters were placed at the upper end of the laparotomy wound until a 5 cm length is inside the rectus sheath. The surgeon held the catheter until the needle was removed. The catheter was then secured and the bacterial filter was assembled. The catheter was flushed with saline 0.9% and the same procedure was repeated on the other side. After that 20 mL of 0.125% bupivacaine + 20 μg fentanyl was injected in each catheter as an initial bolus dose to block the intercostal nerves to provide analgesia through the recovery period until the next dose. In PACU and in SICU, 10 mL of 0.125% bupivacaine + 20 μg fentanyl every 6 hours were administered into each catheter for 48 h. The catheters were inspected every day for signs of infection or obstruction.

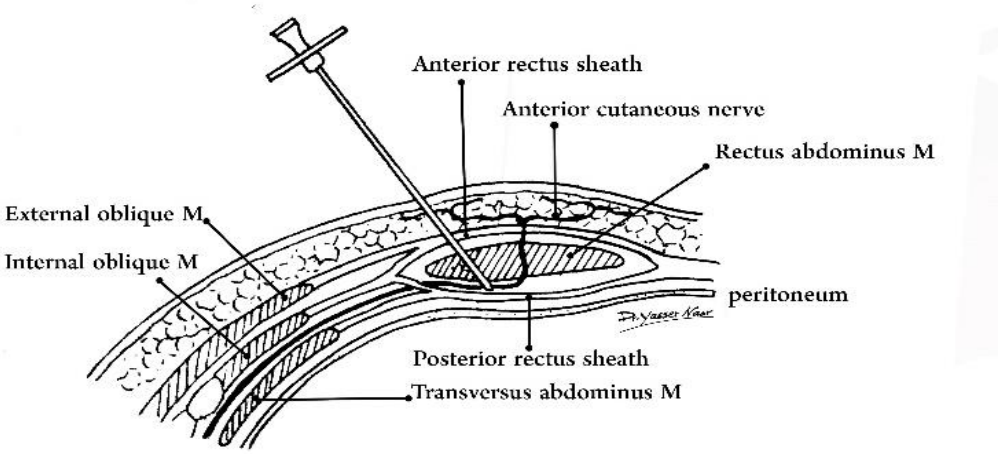


Fig. (1): Touhy needle inserted through the anterior abdominal wall until reaching the potential space between the posterior layer of the rectus sheath and rectus abdominis muscle.

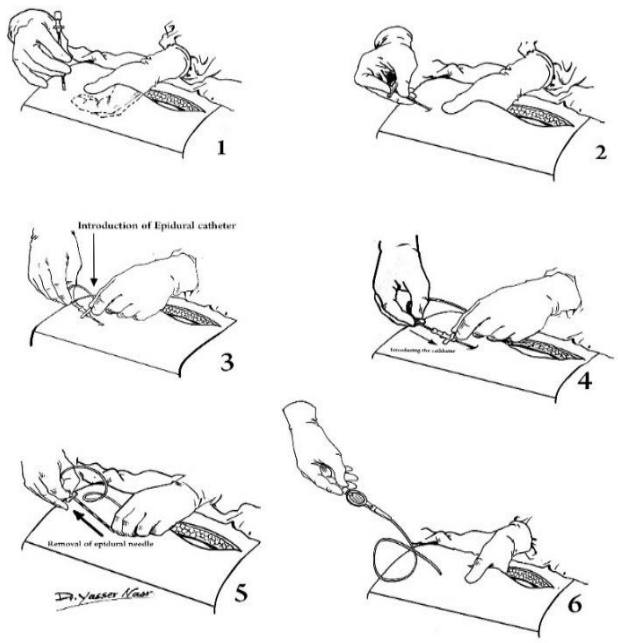


Fig. (2): Steps of surgical insertion of the catheter into the rectus sheath. (1) The surgeon put the non-dominant hand inside the abdomen to locate the needle. (2) The other hand gently pushed the non-traumatic epidural needle in the interface between the peritoneum and muscle layer. (3, 4) The catheter was placed at the upper end of the laparotomy wound until a 5 cm length is inside the rectus sheath. (5) The surgeon held the catheter until the needle was removed. (6) The catheter was then secured and the bacterial filter was assembled.

Patients' monitoring and general anesthesia for both groups:

All patients were closely monitored with electrocardiography, measurement of arterial blood pressure and capnography. All patients of the studied groups were preoxygenated with 100% O_2 for 5 min. Anesthesia was induced by 1 µg/kg fentanyl, propofol 2 mg/kg slowly, and rocuronium bromide at a dose of 0.5 mg/kg to facilitate endotracheal tube insertion. Following induction, mechanical ventilation of the lungs was applied to maintain end tidal carbon dioxide between 35-40 mmHg. Anesthesia was maintained using 1.5 MAC isoflurane. Subsequent doses of rocuronium 0.01 mg/kg were given if needed [according to nerve stimulator train of four (TOF) response]. Additional doses of fentanyl 1 µg/kg were given following clinical data of the patient (if both heart rate and mean arterial blood pressure increased > 20% from baseline despite maintaining adequate depth of anesthesia). By the end of surgery, reversal of neuromuscular block was performed using neostigmine 0.05 mg/kg and atropine 0.02 mg/kg and patients were extubated before transfer to PACU.

- **For both groups:** IV 1 gm paracetamol (Perfalgan)/8h was given to patients. The first dose of paracetamol was given intraoperatively on wound closure.

Opioid-based patient-driven titration protocols have been previously applied [(12)]. Thereby, for patients in both groups, if breakthrough pain occurred, the following plan was applied: ensure that the analgesic protocol of the study has been followed then evaluate the degree of pain according to visual analogue scale (VAS) [(13)], where 0= no pain, and 10= worst pain possible. If VAS is ≥ 4 = inadequate pain relief, **Fentanyl-based patient-driven titration protocol** was followed for supplementary IV analgesia: the patient was given 25 µg fentanyl, if after 5 min VAS is still ≥ 4, another 25 µg fentanyl was given, to be repeated every 5 min if needed with a maximum dose of 1 µg/kg fentanyl.

Failure of the intervention was defined as complete absence of sensory blockade with no improvement in pain severity as reported by the patient after an adequate bolus injection of local anesthetic through either the TEA or RSC. Cases were recorded if occurred.

Collected data:

For all patients, baseline data were collected during visiting the patient 24 hours before surgery. Data were collected from all patients of the study during intra- and post-operative periods (for 48 hours) as follows:

1- Vital signs were recorded every 10 min during intraoperative period (baseline value was measured the day before surgery). During postoperative period, they were recorded every 10 min for the first hour after each time of administration of local anesthetic into the catheters. For the next 5 hours, they were recorded every one hour. This process was repeated during the first 48 h of post-operative period. Vital signs included:
   - Mean arterial blood pressure (MAP): Hypertension (MAP > 30% of basal on two consecutive readings and managed according to the cause whether pain, anxiety, hypothermia, or hypoxia). Hypotension (MAP < 30% of basal, managed by IV fluids and IV ephedrine 0.1 mg/kg and search for the cause).
   - Heart rate (HR): Bradycardia was defined as heart rate < 60 b/min and was planned to be managed by atropine sulphate 0.01 mg/kg. Tachycardia (HR>110 b/min and managed according to the cause whether pain, anxiety, hypothermia, or hypoxia).
   - Respiratory rate (RR): bradypnea (RR < 12 breath/min, managed by lowering or stopping fentanyl) and noninvasive mechanical ventilation. Naloxone 0.01 mg/kg IV was planned to be used in resistant or severe cases.

2- Patient oxygenation were recorded during intraoperative period and the first 48 h of post-operative period. Hypoxia was defined as decreased oxygen saturation (SPO_2) below 91% and was planned to be managed intraoperatively by increasing fraction of inspired oxygen (FiO_2) and/or adding positive end expiratory pressure (PEEP). If occurred during postoperative period it was planned to be managed by applying O_2 nasal cannula 3 L/min or continuous positive airway pressure CPAP in resistant cases.
3- Degree of postoperative pain (using VAS score) [13] and sedation level (using Ramsay sedation scale (RSS) [14] **(Table 1),** were evaluated and recorded at the following postoperative times: 0, 3, 6, 12, 24, 36 and 48 hours; where T_0 = time of arrival of the patient to PACU.
4- Time to first dose of supplementary analgesia with IV fentanyl was recorded in each group (starting from the time of administration of the first dose of local anesthetic into the catheters, to time of VAS ≥ 4).
5- Total intra- and post-operative consumption of fentanyl in each group.
6- Complications were recorded and managed if occurred including postoperative nausea and vomiting (PONV) (to be treated by IV 8 mg ondansetron), pruritus (to be treated by nalbuphine 0.3 mg/kg), dural puncture, postoperative ileus, vital structure injury, hematoma or infection at site of catheter insertion or any other unanticipated complication.
7- After discharge from operation room, all patients were monitored at one-hour intervals for the presence of bowel sounds and/or the passage of flatus in order to allow oral fluid intake. Time of initiation of oral fluid intake was recorded in both groups. Times for the patient to be able to ambulate independently were also recorded. The starting time-point for both functions was the time of administration of the first dose of local anesthetic into the catheters, while the end-point was the time when the patient was able to perform these functions).
8- Patient satisfaction regarding postoperative pain control using a scale of 1-3 (3-Good, 2-Fair, 1-Poor) was recorded.

Table (1): Ramsay sedation scale [14].

Score	Response
1	Anxious or restless or both
2	Cooperative, oriented and tranquil (calm)
3	Responding to command
4	Brisk (quick) response to stimulus
5	Sluggish (slow moving) response to stimulus
6	No response to stimulus

Primary outcome: Degree of postoperative pain at the following postoperative times: 0, 3, 6, 12, 24, 36 and 48 hours; where T_0 = time of arrival of the patient to PACU.

Secondary outcomes: (1) Sedation level at the following postoperative times: 0, 3, 6, 12, 24, 36 and 48 hours; where T_0 = time of arrival of the patient to PACU. (2) Vital signs were recorded during intraoperative period and the first 48 hrs of post-operative period. (3) Patient oxygenation. (4) Time to first dose of supplementary analgesia. (5) Total intra- and post-operative consumption of fentanyl after 48 hrs. (6) Complications if occurred. (7) Times for the patient to be able to ambulate independently and time of initiation of oral fluid intake. (8) Patient satisfaction.

Statistical Analysis

For software data analysis, Statistical Package for the Social Sciences (SPSS version 20.0) was applied. Number and percentage were used to express qualitative data, while, mean ± standard deviation (SD) or median and range were used to express quantitative data. Statistical tests including Chi square test (X^2), ANOVA or Kruskall Wallis were used when appropriate. P value of ≤ 0.05 was considered a significant result and ≤ 0.001 as a highly significant result.

RESULTS

The study subjects: A total of 50 patients were enrolled in the present study. Following randomization, one patient from group thoracic epidural analgesia (TEA) and one patient from group rectus sheath block (RSB) were excluded due to failure of introduction of the catheter. Forty-eight patients (24 in each group) were then statistically analyzed as shown in the flowchart (Figure 3).

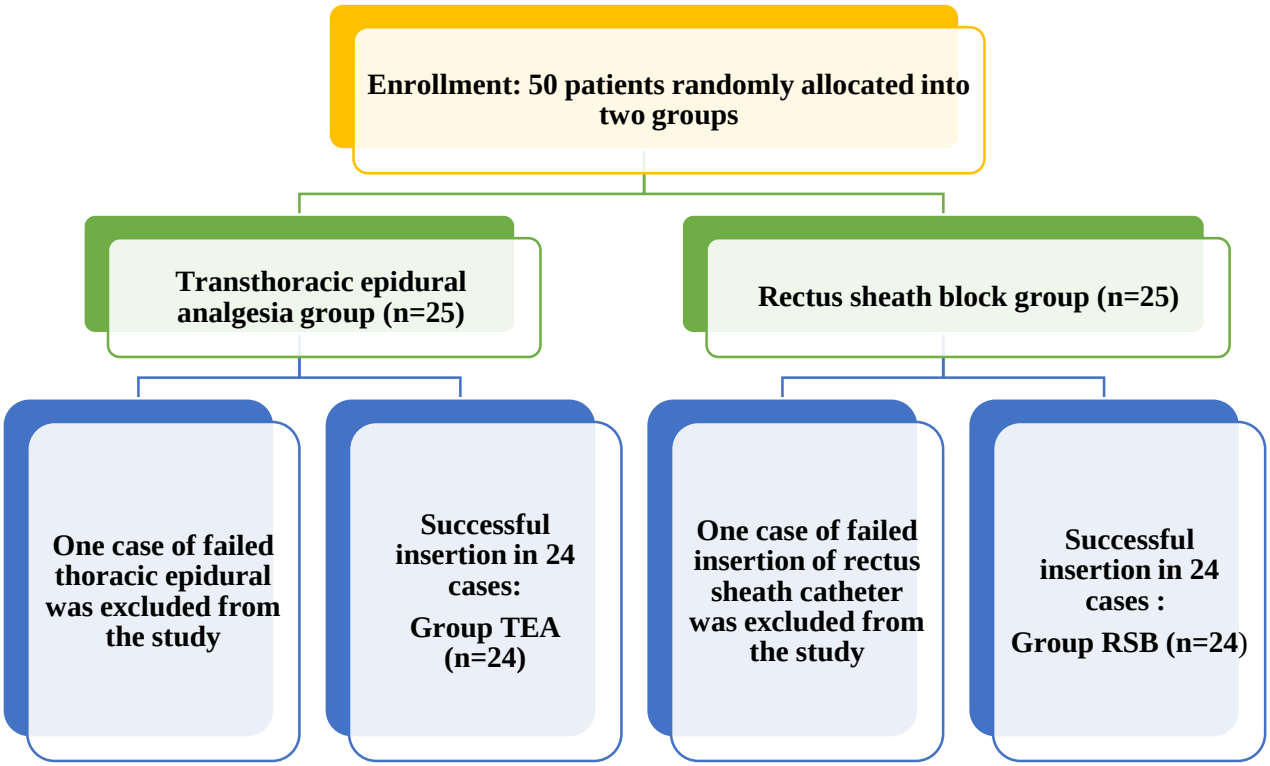


Fig. (3): CONSORT flowchart of the patients enrolled in this study.

In the current study, patients' operative data **(Table 2)** in both groups of the study were comparable.

Table (2): Patients and operative data in both groups of the study

Variable	Group TEA (n=24)	Group RSB (n=24)	*P* value
Age (years)	**44.7 ± 6.3**	**46.2 ± 7.9**	**0.471**
BMI (kg/m^2)	**27.1 ± 2.1**	**26.1 ± 3.8**	**0.265**
Sex (Male/Female) (*n*)	**14/10**	**16/8**	**0.550**
ASA classification I/II/III	**6/8/10**	**5/9/10**	**0.928**
Surgical data			
• Duration of surgery (min):	**189 ± 24**	**195 ± 18**	**0.332**
• Type of surgery (n (%)):			
Right hemicolectomy	**7 (29.2%)**	**6 (25%)**	**0.842**
Left hemicolectomy	**9 (37.5%)**	**11 (45.8%)**	
Segmental colonic resection	**8 (33.3%)**	**7 (29.2%)**	

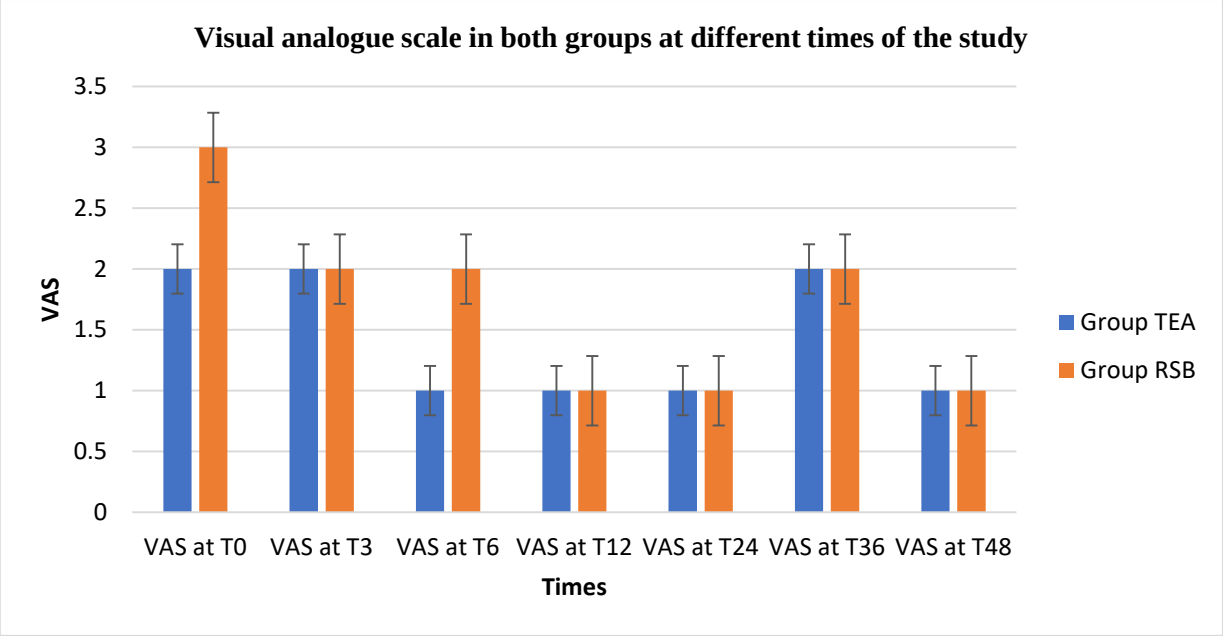
p value was considered statistically significant when <0.05. Data were represented as mean ± SD or number (percent).
BMI: body mass index. **ASA:** American Society of Anesthesiologists. **Group TEA:** transthoracic epidural group.
Group RSB: rectus sheath block group.

Regarding the analgesic performance of the two interventions of the study**,** total intra-operative, total post-operative consumption of fentanyl in 48 h and time to first analgesic requirement, showed no statistically significant differences between both groups of the study (Table 3). Visual analogue scale **(Figure 4)** showed also comparable data between both groups during different times of the study.

Table (3): Analgesic performance in both groups of the study

Variable	Group TEA (n=24)	Group RSB (n=24)	*P* value
Time to first analgesic requirement (min)	**241 ± 51**	**266 ± 34**	**0.052**
Total intra-operative consumption of fentanyl (µg)	**272 ± 45**	**281 ± 37**	**0.453**
Total post-operative consumption of fentanyl in 48 h (µg)	**167± 75**	**174± 68**	**0.736**

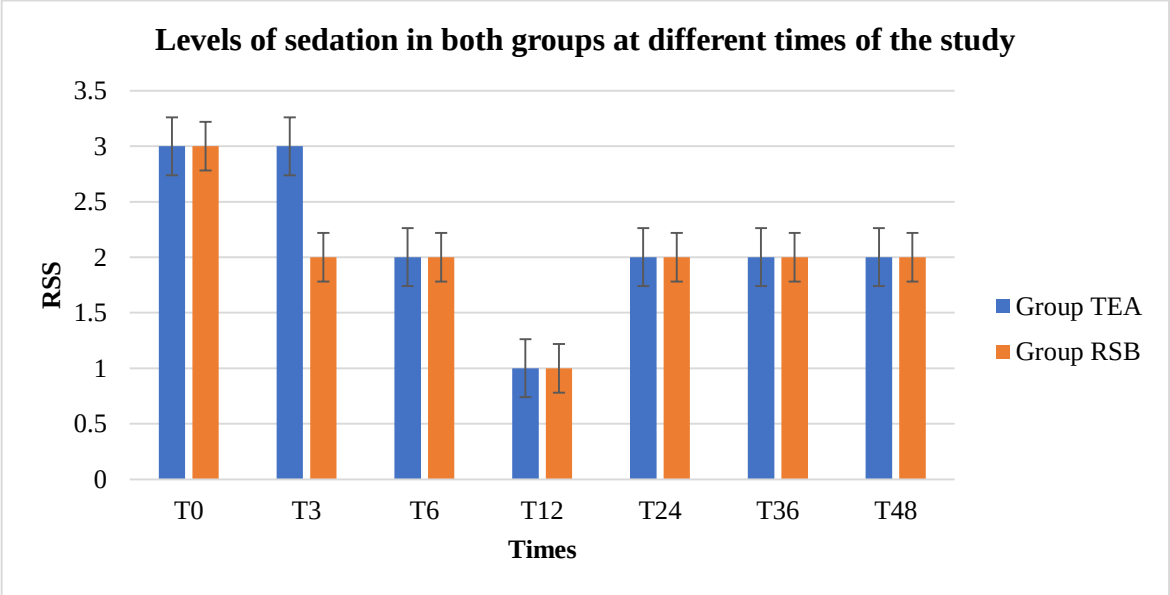
p value was considered statistically significant when <0.05. Data were represented as mean ± SD.
Group TEA: transthoracic epidural group. **Group RSB:** rectus sheath block group



Data were presented by median and range. **Group TEA:** transthoracic epidural group. **Group RSB:** rectus sheath block group.

Fig. (4): Levels of pain according to visual analogue scale (VAS) in both groups during first 48 h of postoperative time.

Sedation level showed no statistically significant difference between both groups during different times of the study **(Figure 5)**.



Data were presented by median and range. **Group TEA:** transthoracic epidural group. **Group RSB:** rectus sheath block group.

Fig. (5): Levels of sedation according to Ramsay sedation scale (RSS) in both groups during the first 48 h of postoperative time.

Intraoperative and postoperative monitoring of vital signs and patients' oxygenation showed no statistically significant differences. **Table (4)** showed that there were no statistically significant differences between both groups regarding mean arterial blood pressure during the first hour after each dose of injection through the catheters during the first 48 postoperative hours.

Table (4): Mean arterial blood pressure monitoring during the first hour after each dose of injection through the catheters in each group during the first 48 postoperative hours

Variable	1st Day			2nd Day		
	Group TEA (n=24)	Group RSB (n=24)	*P* value	Group TEA (n=24)	Group RSB (n=24)	*P* value
Before 1st dose	82.1 ± 9.2	85.9 ± 2.9	0.060	83.1 ± 1.4	82.9 ± 1.1	0.585
10 min	80.3 ± 7.9	83.7 ± 4.8	0.078	80.1 ± 2.4	81.4 ± 2.1	0.052
20 min	81.1 ± 8.4	84.7 ± 4.4	0.069	79.5 ± 2.7	81.1 ± 2.9	0.054
30 min	84.3 ± 6.8	86.1 ± 2.4	0.191	79.1 ± 2.9	80.8 ± 3.7	0.083
40 min	83.9 ± 5.8	85.8 ± 3.1	0.164	80.3 ± 2.4	81.5 ± 3.1	0.141
50 min	84.1 ± 4.9	86.2 ± 2.8	0.075	82.5 ± 1.4	83.2 ± 2.2	0.195
60 min	83.1 ± 5.9	85.6 ± 2.8	0.067	82.9 ± 1.6	83.7 ± 2.6	0.206
Before 2nd dose	83.4 ± 6.7	84.7 ± 3.5	0.404	83.3 ± 1.7	83.5 ± 2.1	0.719
10 min	80.2 ± 7.1	83.4 ± 4.3	0.065	78.8 ± 2.9	80.6 ± 3.4	0.054
20 min	82.5 ± 6.3	85.3 ± 2.7	0.051	78.9 ± 2.7	80.4 ± 3.1	0.080
30 min	83.4 ± 6.3	86.0 ± 1.6	0.056	82.1 ± 2.9	83.3 ± 2.1	0.107
40 min	84.4 ± 3.9	85.9 ± 2.2	0.108	83.4 ± 1.7	84.1 ± 2.2	0.224
50 min	84.1 ± 5.6	86.7 ± 3.5	0.060	84.1 ± 0.9	84.5 ± 1.7	0.314
60 min	84.9 ± 3.4	86.3 ± 1.1	0.061	83.9 ± 1.4	84.1 ± 2.0	0.690
Before 3rd dose	86.1 ± 1.4	85.9 ± 1.7	0.658	84.6 ± 1.7	84.7 ± 2.3	0.865
10 min	80.9 ± 2.6	82.8 ± 3.9	0.053	79.5 ± 2.4	81.1 ± 3.3	0.061
20 min	81.2 ± 2.9	83.1 ± 4.4	0.084	79.1 ± 2.1	80.4 ± 2.7	0.069
30 min	81.1 ± 2.1	82.6 ± 3.6	0.085	79.3 ± 2.9	80.2 ± 2.3	0.240
40 min	81.7 ± 2.8	83.3 ± 4.0	0.115	80.3 ± 2.1	81.2 ± 2.8	0.214
50 min	82.4 ± 2.7	83.6 ± 4.1	0.237	84.1 ± 1.1	84.4 ± 1.7	0.472
60 min	82.0 ± 2.4	83.1 ± 4.6	0.304	83.8 ± 2.4	84.1 ± 2.2	0.654
Before 4th dose	83.7 ± 1.4	84.1 ± 2.2	0.456	85.2 ± 3.1	84.9 ± 3.6	0.758
10 min	79.8 ± 4.9	81.8 ± 1.1	0.057	80.1 ± 1.3	81.2 ± 2.7	0.053
20 min	79.9 ± 1.1	81.2 ± 3.2	0.066	79.0 ± 2.6	80.5 ±3.1	0.076
30 min	80.0 ± 1.2	81.3± 3.1	0.062	82.8 ± 2.2	83.4 ± 2.7	0.403
40 min	81.9 ± 0.8	81.6 ± 1.4	0.367	83.3 ± 3.2	84.6 ± 3.7	0.199
50 min	82.1 ± 1.3	82.5 ± 1.9	0.399	84.9 ± 3.6	84.7 ± 3.1	0.838
60 min	82.4 ± 1.7	82.1 ± 1.5	0.520	85.1 ± 3.3	84.9 ± 3.7	0.844

Data were represented as mean ± SD. **Group TEA:** transthoracic epidural group. **Group RSB:** rectus sheath block group.

Regarding the recovery parameters of the patients, patients in group TEA showed statistically significant shorter time for first oral fluid intake than those in group RSB (10.4 ± 6 h, vs 14.1 ± 5 h respectively). There was statistically significant shorter time for independent ambulation in group RSB (18.7 ± 3 h) compared to group TEA (29.6 ± 12 h). The incidence of PONV was statistically significant higher in group TEA (37.5% = 9 patients) than in group RSB (12.5% = 3 patients). Incidence of pruritus was statistically significantly higher in group TEA (25 % = 6 patients) than in group RSB (4.2% = 1 patients). There were no other recorded complications in both groups (Table 5).

Table (5): Recovery parameters and incidence of complications in both groups of the study

Variable	Group TEA (n=24)	Group RSB (n=24)	*P* value
Time to first oral intake (h)	**10.4 ± 6***	**14.1 ± 5**	**0.025**
Time for independent ambulation (h)	**29.6 ± 12**	**18.7 ± 3***	**0.000**
PONV: n (%)	**9 (37.5%) ***	**3 (12.5%)**	**0.046**
Pruritus: n (%)	**6 (25%) ***	**1 (4.2%)**	**0.041**

p value was considered statistically significant when <0.05. Data were represented as mean ±SD or number (percent). *Denotes statistically significant difference. **Group TEA:** transthoracic epidural group. **Group RSB:** rectus sheath block group. **PONV**: postoperative nausea and vomiting.

Regarding patients' satisfaction, there was statistically significant difference in favor for group RSB (83.3 % = 20 patients described the technique as good in group RSB, compared to 54.2% = 13 patients in group TEA). The lower level of satisfaction in group TEA was attributed by the patients to the associated complications including nausea and pruritus (Table 6).

Table (6): Patients' satisfaction scale

Satisfaction scale	Group TEA (n=24)	Group RSB (n=24)
1 (Poor)	0	0
2 (Fair)	11 (45.8%)	4 (16.7%)
3 (Good)	13 (54.2%)	20 (83.3) *
***P* value**	0.029	

p value was considered statistically significant when <0.05. Data were represented as number (percent). *Denotes statistically significant higher difference as compared to the other group. **Group TEA:** transthoracic epidural group. **Group RSB:** rectus sheath block group

DISCUSSION

To our knowledge, no randomized trials compared surgically inserted RSC analgesia to TEA in previous literatures. The existing published studies were concerned with what to inject through the surgically inserted RSC [15, 16], non-randomized trials [17, 18] or a case report [19].

Smith *et al.* [20] in their study used blind bilateral rectus sheath blocks for diagnostic laparoscopy. They reported significant decrease in both postoperative pain and postoperative analgesic requirements. Later on, **Smith *et al.*** [21] again reported a reduction in opioid use with rectus sheath block. **Cornish and Deacon** [22] described surgical placement of RSC for postoperative analgesia after upper abdominal surgery and found it as a beneficial technique that controlled somatic pain and lower doses of opioids were used to control visceral pain only. **McDermott *et al.*** [8] have found that surgically inserted RSC as a quick and safe analgesic technique that avoids the use of ultrasound, which is not available in every medical institute. In addition to that it also avoids the potential side effects of epidural anesthesia.

In the present study, RSB provided postoperative analgesia that is comparable to TEA. In accordance with this result is the results obtained by **Tudor *et al.*** [23] and **Turky *et al.*** [24]. Moreover, RSCs were inserted after the induction of general anesthesia which is preferred by the patients with no postoperative serious complications [9, 10]. On the other hand, in their study, **Turky *et al.*** [24] found that TEA was associated with lower consumption of postoperative fentanyl than RSA with better opioid sparing effect. These results were not in accordance with the results of the current study as postoperative fentanyl consumption was comparable between both groups of this study. The regularly added 1 gm paracetamol every 8 hours in the current study might have abolished the visceral pain that was expected to occur in RSC group. Thereby, patients did not need more doses of supplementary fentanyl. Visceral pain is a severe form of pain that is spared when local blocks such as RSB are performed, and it usually subsides within 6 h of the first 24 hours post-operatively [9, 14] by using intravenous non-steroidal anti-inflammatory drugs (NSAID) or paracetamol [25]. Another explanation for this variation might be that in the study by **Turky *et al.*** [24], local anesthetic through epidural catheter was given as continuous infusion while RSB was given as intermittent doses every 12 hours, which might be too long. In the current study, equivalent interrupted doses of local anesthetic and fentanyl were given through the catheters to both groups at 6 hours interval.

Epidural analgesia using combined fentanyl and bupivacaine is associated with some potential side effects including hypotension, pruritus, nausea and vomiting, and difficulty to ambulate [26]. Pruritus and PONV are side effects for neuraxial use of fentanyl [27]. In the current study pruritus was recorded in TEA group, which is in agreement with the results obtained by a previous study [28]. Incidence of PONV was also higher with TEA in the present study, which is in accordance with the results obtained by **Kawai *et al.*** [29]. Pruritus in this study was managed using low dose of nalbuphine (0.3 mg/kg), which did not attenuate the analgesic effect and did not increase the depth of sedation, which is in agreement with an earlier study [30].

Upright mobilization after upper abdominal surgery has been defined as the time taken to achieve a mobility goal such as sitting out of bed, moving with assistance, or ambulating independently [31]. The results obtained by **Tudor *et al.*** [23] are in accordance with the results of this study which concluded that RSB was associated with earlier time to ambulate compared to TEA. The early postoperative mobilization with RSB was also recorded in other studies [17, 18].

Post-operative recovery protocols following colonic surgeries pay a lot of attention for early feeding within 24 hours if possible. Thereby, reducing the incidence of postoperative ileus should be considered [32]. Patients in TEA group in the present study showed earlier recovery of gastric motility, which supports the results obtained by earlier studies [33].

Limitations of the study: (1) The study was not double blind. (2) Cost/benefit was not calculated.

CONCLUSION

Analgesia through surgically placed rectus sheath catheters is a safe and effective alternative to thoracic epidural analgesia in major abdominal midline laparotomies, which might be of special value if thoracic epidural analgesia could not be done or contraindicated.

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REFERENCES

1. **Gustafsson U, Scott M, Schwenk W *et al.* (2013):** Guidelines for perioperative care in elective colonic

surgery: Enhanced Recovery after Surgery (ERAS) Society Recommendations. World J Surg., 37: 259-284.

2. **Block B, Liu S, Rowlingson A *et al.* (2003):** Efficacy of postoperative epidural analgesia: a meta-analysis. JAMA., 290 (18): 2455-2463.
3. **Holte K, Kehlet H (2000):** Postoperative ileus: a preventable event. J Surg., 87: 1480- 1493.
4. **Steinbrook R (1998):** Epidural anesthesia and gastrointestinal motility. Anesth Analg., 86 (4): 837-844.
5. **Gould T, Grace K, Thorne G *et al.* (2002):** Effect of thoracic epidural anaesthesia on colonic blood flow. Br J Anaesth., 89: 446-451.
6. **Bonnet F, Marret E (2005):** Influence of anaesthetic and analgesic techniques on outcome after surgery. Br J Anaesth., 95 (1): 52-58.
7. **Cook T, Counsel D, Wildsmith J (2009):** Major complications of central neuraxial block: report on the 3rd National Audit Project of the Royal College of Anaesthetists. Br J Anaesth., 102: 179-190.
8. **McDermott F, Wilson I, Boorman P (2010):** The Placement of Rectus Sheath Catheters by Surgeons to Reduce Pain Following Laparotomy. Anaesthesia Tutorial of the Week, 195: 1-6.
9. **Webster K (2010):** Ultrasound guided rectus sheath block - analgesia for abdominal surgery. Update Anaesth., 26: 12-17.
10. **Sandeman D, Dilley A (2008):** Ultrasound-guided rectus sheath block and catheter placement. ANZ J Surg., 78: 621-623.
11. **Knuf K, Maani C, Cummings A (2018):** Clinical agreement in the American Society of Anesthesiologists physical status classification. Perioper Med (Lond), 7: 14-18.
12. **Chang A, Bijur P, Davitt M *et al.* (2009):** Randomized clinical trial comparing a patient-driven titration protocol of intravenous hydromorphone with traditional physician-driven management of emergency department patients with acute severe pain. Ann Emerg Med., 54: 561-567.
13. **Huskisson E (1974):** Measurement of pain. Lancet, 2: 1127–1131.
14. **Ramsay M, Savege T, Simpson B *et al.* (1974):** Controlled sedation with alphaxalone–alphadolone. Brit Med J., 2: 656-659.
15. **Padmanabhan J, Rohatgi A, Niaz A *et al.* (2007):** Does rectus sheath infusion of bupivacaine reduce postoperative opioid requirement? Ann R Coll Surg Engl., 89: 229-232.
16. **Shido A, Imamachi N, Doi K *et al.* (2010):** Continuous local anesthetic infusion through ultrasound-guided rectus sheath catheters. Can J Anaesth., 57 (11): 1046-1047.
17. **Parsons B, Aning J, Daugherty M *et al.* (2011):** The use of rectus sheath catheters for patients undergoing radical cystectomy. BJMSU., 4: 24-30.
18. **Dutton T, McGrath J, Daugherty M (2014):** Use of rectus sheath catheters for pain relief in patients undergoing major pelvic urological surgery. BJU Int., 113: 246-253.
19. **Malchow R, Jaeger L, Lam H (2011):** Rectus Sheath Catheters for Continuous Analgesia after Laparotomy without Postoperative Opioid Use. Pain Medicine, 12: 1124–1129.
20. **Smith B, Suchak M, Siggins D *et al.* (1988):** Rectus sheath block for diagnostic laparoscopy. Anaesthesia, 43: 947–948.
21. **Smith B, MacPherson G, de Jonge M *et al.* (1991):** Rectus sheath and mesosalpinx block for laparoscopic sterilization. Anaesthesia, 46: 875–877.
22. **Cornish P, Deacon A (2007):** Rectus sheath catheters for continuous analgesia after upper abdominal surgery. ANZ J Surg., 77: 84-88.
23. **Tudor E, Yang W, Brown R *et al.* (2015):** Rectus sheath catheters provide equivalent analgesia to epidurals following laparotomy for colorectal surgery. Ann R Coll Surg Engl., 97: 530-533.
24. **Turky D, Ibrahim I, Elzohry A (2018):** Peri-operative Rectus Sheath Fentanyl-levobupivacaine Infusion vs. Thoracic Epidural Fentanyl Levobupvacaine Infusion in Patients Undergoing Major Abdominal Cancer Surgeries with Medline Incision. J Pain Relief, 7 (3): 318-326.
25. **Liu S, Carpenter R, Mackey D *et al.* (1995):** Effects of perioperative analgesic technique on rate of recovery after colon surgery. Anesthesiology, 83: 757-765.
26. **Scott D, Beilby D, McClymont C (1995):** Postoperative Analgesia Using Epidural Infusions of Fentanyl with Bupivacaine: A Prospective Analysis of 1,014 Patients. Anesthesiology, 83: 727-737.
27. **Panos L, Sandler A, Stringer D *et al.* (1990):** Continuous infusions of lumbar epidural fentanyl and intravenous fentanyl for post-thoracotomy pain relief. Can J Anaesth., 37: 66-71.
28. **Szarvas S, Harmon D, Murphy D (2003):** Neuraxial opioid-induced pruritus: a review. J Clin Anesth., 15: 234–239.
29. **Kawai K, Sanuki M, Kinoshinta H (2004):** Postoperative nausea and vomiting caused by epidural infusion following gynecological laparoscopic surgery: Fentanyl and ropivacaine versus ropivacaine alone. Masui., 53 (12): 1381-1385.
30. **Jannuzzi R (2013):** Nalbuphine for the treatment of opioid-induced pruritus: a systematic review. J Pain, 14 (4): 10-14.
31. **Mackay M, Ellis E (2002):** Physiotherapy outcomes after open abdominal surgery. Physiotherapy Theory and Practice, 18: 75–93.
32. **Carmichael J, Keller D, Baldini G *et al.* (2017):** Clinical Practice Guidelines for Enhanced Recovery After Colon and Rectal Surgery from the American Society of Colon and Rectal Surgeons and Society of American Gastrointestinal and Endoscopic Surgeons. Dis Colon & Rectum, 60 (8): 761-784.
33. **Taqi A, Hong X, MistraIetti G *et al.* (2007):** Thoracic epidural analgesia facilitates the restoration of bowel function and dietary intake in patients undergoing laparoscopic colon resection using a traditional, nonaccelerated, perioperative care program. Surg Endosc., 21 (2): 247-252.