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Cohort Study

Rectus sheath block and emergency midline laparotomy at a hospital in Ethiopia: A prospective observational study

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ABSTRACT

Background: Midline laparotomy is associated with severe postoperative pain. Literature showed controversial results regarding the efficacy of the rectus sheath block.
Methods: This is a prospective cohort study that recruits 30 patients in the rectus sheath block (RSB) group and 30 patients in the multimodal analgesia (MMA) group who underwent emergency midline laparotomy. The RSB was performed by an experienced anesthetist using a land-mark technique. Independent *t*-test and Mann-Whitney-U test were used for numeric data while Chi-Square or Fisher exact test was used for categorical variables. P-values < 0.05 were considered as statistically significant.
Results: The numeric rating scale score at the recovery was significantly reduced in an RSB group with a p-value of 0.039. Postoperative numeric rating scale scores at 3rd, 6th, 12th, and 24th hours were statistically significantly lower in the RSB group. Postoperative tramadol consumption in 24 h was significantly lower with a p-value of 0.0001 for the rectus sheath group.
Conclusions: For midline laparotomy, adding a bilateral rectus sheath block at the end of the operation might be an effective postoperative analgesia option.

1. Introduction

The International Association for the Study of Pain defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage [1]. Laparotomies that necessitate midline incisions were commonly accompanied by postoperative pain, typically associated with neuro-endocrine stress response [2,3]. Postoperative analgesia enhances early mobilization and decreases the incidence of postoperative pneumonia and deep venous thrombosis [4,5].

Administration of multimodal analgesics could limit the excessive use of systemic opioid analgesia and its side effects [4–8]. Good post-operative pain management improves the wound healing process [9]. Postoperative pain management minimizes the feeling of discomfort and makes the treatment more economic, however, there is no ideal method available for this [10,11].

Schleich firstly described RSB in 1899 aiming at the deposition of local anesthetic (LA) in the virtual space between the posterior wall of the rectus abdominis muscle and its sheath [12]. The anesthetic injected into this space is proposed to spread freely up and down and to block the anterior branches of the thoracoabdominal nerves before they leave the rectus sheath [13–15].

The central portion of the anterior abdominal wall is innervated by the ventral branches of the lower thoracic nerves (T6-T12); these ventral branches lie between the rectus abdominis muscle (deep) and the posterior rectus sheath (ventral) and enter the rectus muscle near the midline [16–19]. The RSB can be performed using a blind technique when there is no access to ultrasound in a resource-limited setting like ours [17,18,20–22]. This study aims to assess the postoperative analgesic efficacy of the rectus sheath block for emergency midline laparotomy. In this study, we hypothesized that there is a difference in the time to first analgesic request, postoperative pain severity score (NRS), and the total post-operative analgesic consumption within 24 h between the multimodal analgesia group and rectus sheath block group.

2. Methods

2.1. Study setting, design, period, and population

A Hospital-based prospective cohort study was conducted at Xx

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Hospital, in North-central Ethiopia from February 01 to March 30, 2019. The Hospital gives medical, surgical, pediatrics, gynecologic, and obstetrics services. Patients who have undergone emergency midline laparotomy at the study setting were the source population while selected patients who underwent emergency midline laparotomy during the study period were the study population. Patients with a psychiatric diagnosis, age less than 18, and patients who were chronic opioid users were excluded. This study is reported in line with STROCCS criteria [23]. It is registered at www.researchregistry.com with Research Registry UIN: researchregistry5844 and available at https://www.researchregistry.com/browse-the-registry#home/registrationdetails/5f1dfd81ebfc400016eeb0bd/.

Ethical permission was obtained from a research ethics committee of Debre Tabor University college of Health sciences. The permission was taken from Xx Hospital. Informed consent was secured from all study participants after telling them the aim, benefit, and risk of participating in the study.

2.2. Sample size determination

The sample size was determined by using a statistical power of 80% ($\beta = 0.2$) and a statistical significance of 0.05 and means and standard deviations for each outcome variable of the groups were taken from a previous study [24]. The ratio of treatment to control (1:1). The sample size was calculated by constituting the values into G-power for all outcome variables.

Visual Analogue Scale score in RSB group: $\mu1 = 1.16$, $SD1 = 1.20$, the calculated sample size for RSB group = 31; Visual Analogue Scale score in MMA group: $\mu2 = 1.83$, $SD2 = 0.74$, the calculated sample size for MMA group = 31. By adding 5% contingency the total required patients were 66.

2.3. Sampling techniques and procedures

A systematic random sampling technique was used to select study participants. The sampling interval k was determined to be approximately 2 using the formula: $k = N/n$ (95/66); where n = total sample size, N = population per two months. Each participant had about 50% equal probability of being included in the study. A schedule list of midline laparotomy was used as a sampling frame and the first random start was determined by a simple lottery method then the skipping interval was used for the rest of the study participants till the sample size was completed. The selected study participants were allocated to either of the group based on what they had been given for postoperative pain management plan (MMA or RSB).

2.4. Operational definition

Midline Laparotomy: It is an abdominal cavity operation through a midline incision of the abdomen, from xiphisternum to symphysis pubis.

NRS: This is a valid pain intensity assessment tool that involves asking a patient to rate his or her pain from 0 to 10 (11point scale) with the understanding that 0 is equal to no pain and 10 equals to the worst possible pain. NRS is reliable in a rural population irrespective of literacy status [25].

Baseline vital signs: Vital signs (Diastolic blood pressure, Systolic blood pressure, and Heart rate) recorded on the anesthetic monitoring before the induction of anesthesia.

2.5. Data collection procedures and tools

Data was collected by using a prepared questionnaire starting from intraoperative to 24 h postoperatively. The RSB was performed by an experienced anesthetist using a land-mark technique [26,27]. The patient lying supine, a point is identified 3 cm from midline then passing a short-beveled 5 cm needle through the anterior rectus sheath ("pop" felt) and through the rectus abdominis muscle and the needle is advanced further until a firm resistance was felt. After negative aspiration for blood, 20 ml of 0.25% bupivacaine was deposited on the posterior wall of the rectus sheath. The procedure was repeated on the opposite side of the midline (Fig. 1).

The severity of pain by using NRS [25], time for the first analgesic request (in hours), 24 h analgesics consumption and incidence of postoperative nausea and vomiting were collected by two anesthetists. Data was gathered at five-time points: at 0 (immediately at recovery), 3, 6, 12, and 24 h postoperatively. Postoperative pain was managed by diclofenac and/or tramadol based on patient request and/or pain severity score (NRS) greater than three.

2.6. Data quality control

Before the actual data collection pretest was done on 10% of the sample size to see the effectiveness of the data collecting tool and questionnaire. Collected data were checked for completeness, accuracy, and clarity.

2.7. Statistical analysis

Data were checked manually for completeness, coded, and entered into the SPSS version 23 computer program. Descriptive statistics were used to summarize data. Chi-square or Fisher exact test was used for discrete variables and a student's t-test was used for comparing numerical variables of normally distributed data or Mann-Whitney-U test was used for skewed data. A P-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Demographic and perioperative characteristics

Data were collected from sixty patients. Six patients from the multimodal analgesia group and rectus sheath block group were lost to follow up. Demographic data such as age, sex, and ASA status were comparable between the multimodal analgesia group and rectus sheath block group (Table 1).

3.2. Preoperative vital signs

Preoperative vital signs expressed in the median and interquartile range were comparable between two the multimodal analgesia group and rectus sheath block group (Table 2).

3.3. Perioperative characteristics of patients

Types of induction agents, muscle relaxants, pre-medications, analgesics, and diagnosis were expressed in frequency and percentage (Table 3).

3.4. Postoperative vital signs

The postoperative vital signs were taken immediately at the arrival of the recovery room, 6th, 12th, and 24th hours postoperatively were statistically significant differences between the multimodal analgesia group and rectus sheath block group (Table 4).

3.5. Comparison of postoperative pain severity by numeric pain rating scale

The median NRS score was lower in the RSB group at 0 (immediately at the arrival of recovery room), 3rd, 6th, and 12th hours postoperatively (p-values < 0.05) (Table 5).

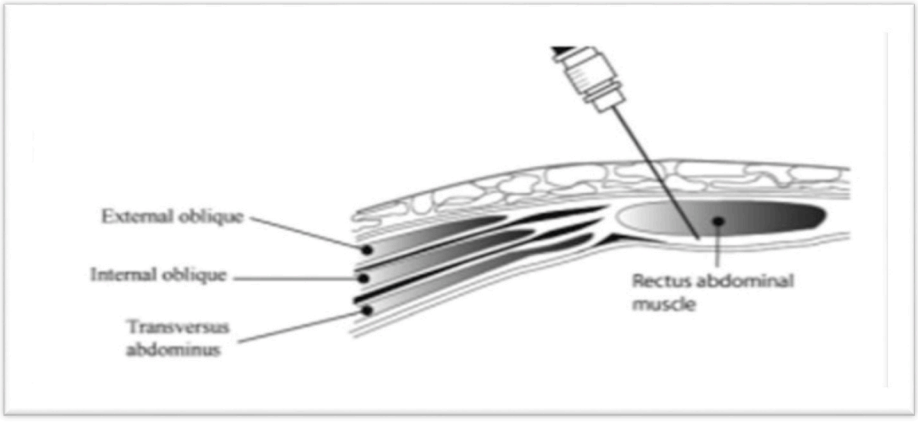

Fig. 1. Rectus sheath block, with depiction of needle position and location of local anesthetic injection.

Table 1
Demographic characteristics of patients who underwent emergency midline laparotomy at Xx Hospital.

Variables	RSB group (n = 30)	MMA group (n = 30)
Age (mean ± Standard deviation)	45 ± 13	44 ± 15
Sex (F/M)	16/14	17/13
ASA status, n (%)		
ASA 1	21(70%)	20(67%)
ASA 2	9(30%)	10(33)

Hint M: male; F: Female; ASA: American Society of Anesthesiology.

Table 2
Preoperative vital signs of patients who underwent emergency midline laparotomy at Xx Hospital.

Variable	RSB group (n = 30)	MMA group (n = 30)	P-value
Base line heart rate	80(69.7–83.2)	80(68–90)	1.000
Base line systolic blood pressure	121(110–130)	124(111–135)	0.605
Base line diastolic blood pressure	75(70–80)	76(70–80)	0.429

Table 3
The intraoperative characteristics of patients who underwent emergency midline laparotomy at Xx Hospital.

Variables	RSB group (n = 30)	MMA group (n = 30)
Types of induction agent		
Ketamine	19(32%)	17(28%)
Propofol	5(8%)	6(10%)
Ketofol	6(10%)	7(12%)
Diagnosis		
Sigmoid volvulus	8(14%)	7(12%)
Blunt abdominal injury	6(10%)	7(12%)
Perforated appendicitis	8(13%)	9(15%)
Small bowel obstruction	5(8%)	5(8%)
Other	3(5%)	2(4%)
Analgesia		
Tramadol	15(25%)	14(24%)
Pethidine	9(15%)	11(18%)
Diclofenac	6(10%)	5(8%)
Types of induction		
Suxamethonium	23(38%)	22(37%)
Vecuronium	7(12%)	8(13%)

Table 4
Postoperative vital signs expressed in median (interquartile range) of patients who underwent emergency midline laparotomy at Xx Hospital.

Variable	RSB group (n = 30)	MMA group (n = 30)	P-value
SBP immediately at arrival of recovery room	124 (119.5–129)	128(121.5–129)	0.009**
DBP immediately at arrival of recovery room	74(70–82.5)	70(70–80)	0.439
PR immediately at arrival of recovery room	89(83.3–92)	82(70–88.5)	0.789
SBP at 3rd hour postoperative	120(120–124)	120(119.5–128)	0.288
DBP at 3rd hour postoperatively	72(70–80)	70(70–78.5)	1.00
PR at 3rd hour postoperatively	80(78–85)	84.5(82–98)	0.111
SBP 6th hour postoperatively	116(110–124)	120(115–128.5)	0.010**
DBP 6th hour postoperatively	77(70–80)	73.5(70–78.5)	0.796
PR 6th hour postoperatively	81(77.5–82)	82(80–88.8)	0.438
SBP at 12th hour postoperatively	110(100–118)	120(115-127	0.0001**
DBP at 12th hour postoperatively	70(70–75)	75(70–80)	0.020**
PR at 12th hour postoperatively	80(71–80)	75(70–80)	0.110
SBP at 24th hour post operatively	115.5 (100–120)	122.5 (119.5–129)	0.006**
DBP at 24th hour post operatively	80(70–80)	79(69.8–80.3)	0.160
PR at 24th hour post operatively	80.5(74–85)	80(75–89)	0.796
First analgesic request (in hours)	8(7–9)	2(1–2.3)	0.001**

Hint** = statistically significant; DBP: Diastolic Blood Pressure; PR: Pulse Rate; SBP: Systolic Blood Pressure.

Table 5
The median (IQR) Numeric Rating Scale score between the multimodal analgesia group and rectus sheath block group of patients who underwent emergency midline laparotomy at Xx Hospital.

Variable	RSB group (n = 30)	MMA group (n = 30)	P-value
NRS immediately at the arrival of recovery room	3(3–4)	4.5(3–4.5)	0.039**
NRS at 3rd hour post operatively	3(3–4)	5(4–6)	0.0001**
NRS at 6th hour post operatively	3(3–4)	4(4–5)	0.030**
NRS at 12th hour post operatively	3(3–5)	4(4–6)	0.041**
NRS at 24th hour postoperatively	3(3–4)	5(3.8–6)	0.0001**

Hint: ** = statistically significant, NRS: Numeric Rating Scale.

3.6. Comparison of total analgesics consumption between the multimodal analgesia group and rectus sheath block group

The tramadol consumption in milligram was 25(25–50) and 150 (100–200) while diclofenac consumption in milligram was 0(0–75) and 75(75-75) in rectus sheath block and multi-modal analgesia group with p-values of 0.0001 and 0.013 in the first 24 h postoperatively.

3.7. Incidence of postoperative nausea and vomiting

The incidence of postoperative nausea and vomiting over 24 h decreased in the RSB group. As indicated by the proportion of postoperative nausea and vomiting in the RSB group was (36.7%) compared to the control group (50%) with a p-value of 0.0001.

4. Discussion

The RSB was performed by an experienced anesthetist using a landmark technique [27]. After confirming the potential place and a negative aspiration for blood, 20 ml of 0.25% bupivacaine was deposited on the posterior wall of the rectus sheath bilaterally. In this study, the severity of pain by using NRS, time to first analgesic request and 24 h analgesics consumption were the primary outcome variables while the incidence of postoperative nausea and vomiting was a secondary outcome variable. This study demonstrates that RSB in patients undergoing emergency midline laparotomy resulted in statistically significant lower pain scores when compared with a multi-modal analgesia group immediately at the recovery room. The pain severity score in NRS was also lower in the RSB group at 3rd, 6th, 12th hours postoperatively. Twenty-four hours of analgesics consumption were reduced in the RSB group. This study found that the incidence of postoperative nausea and vomiting in the RSB group was lower when compared to the MMA group over 24 h postoperatively.

In line with our findings, studies done by Purdy M. et al., Bashandy G. et al., Ibrahim M. et al., Smith B. et al. and Allene MD showed that RSB is effective in reducing the severity of postoperative pain score, analgesics consumption and increases time to first analgesic request [28–32]. While other studies failed to demonstrate RSB effectiveness [22,33].

Though there was a proportional difference among the multimodal analgesia group and rectus sheath block group for the incidence of postoperative nausea and vomiting, there was no statistically significant difference between the multimodal analgesia group and rectus sheath block group. Contrarily, the studies done by allene MD and Elbahrawy ED showed a statistically significant difference between two groups in the incidence of nausea and/or vomiting within 24hr between the groups [32,34].

Currently, the important factor that could affect the duration and recovery from postoperative ileus might be decreasing the dose of narcotics [35]. The limitation of this study could be the study design was not a randomized controlled trial.

5. Conclusions

The bilateral rectus sheath block might be an effective analgesic option for midline laparotomy. This block is effective in reducing the first 24 h of postoperative analgesic consumption. The incidence of postoperative nausea and vomiting over 24 h decreased in the RSB group as compared to the MMA group.

Funding

No.

Conflict of interest

The authors declare that there is no conflict of interests.

Ethics approval and consent to participate

An ethical permission was obtained from a research ethics committee of Debre Tabor University college of Health sciences. The permission was taken from Debre Tabor Comprehensive Specialized Hospital. Informed consent was secured from all study participants after telling them the aim, benefit and risk of participating in the study. The anonymity of the patient's information was kept confidential.

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Nothing to declare

Authors' contributions

All authors equally participated in write up of the proposal, data entry, data analysis and final manuscript preparation. The final manuscript is read and approved by all authors.

Consent

Informed consent was taken from a parent of the study participants after telling them the aim of the study, benefit, harm of participating in the study, and they have been told as they can withdraw from the study at any step if they feel so.

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Guarantor

Mr. Diriba Teshome.

Availability of data and materials

Data and materials will be shared upon reasonable request.

Provenance and peer review

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Declaration of competing interest

Nothing to declare.

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Abbreviations/acronyms

ASA	American Society of Anesthesiology
RSB	Rectus Sheath Block
LA	Local Anesthesia

NRS Numeric Rating Scale
IQR Inter Quartile Range.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.102572.

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Author contribution

All authors equally contributed to the study concept or design, data collection, data analysis or interpretation, writing the paper.

Registration of research studies

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Guarantor

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