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The effect of rectus sheath block as a supplement of general anesthesia on postoperative analgesia In adult patients undergoing midline abdominal surgeries

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Abstract

Background: Landmark guided rectus sheath block can block the ventral rami of the 7th to 12th thoracolumbar nerves by injection of local anaesthetic into the space between the rectus muscle and posterior rectus sheath. The aim of this randomized double-blind study was to evaluate the analgesic effect of the bilateral landmark guided rectus sheath block as supplement of general anaesthesia in patients undergoing midline abdominal surgeries.

Methods: After the hospital ethical committee approval, 60 (ASA I–II) adult patients scheduled for midline abdominal surgeries were included in this study. The group 1 (n=30) patients received only general anaesthesia. In the group 2 (n = 30) patients received a bilateral landmark guided rectus sheath block with 40 ml of 0.25% bupivacaine before extubation. In this study we assessed demographic and clinical characteristics, pain score - VNRS at rest at 2, 4, 6, 12,16 and 24 hours after operation and total analgesic consumption of diclofenac dose over 24-hours

Results: There were statistically significant differences in VNRS scores between the groups 1 and 2 at 2hr, 4 hr, 6 hr, 12 hr, 16 hr and 24 hr postoperatively ($P < 0.001$). The cumulative 24 hours diclofenac consumption after the operation was significantly lower in the group B (mean = 75 ± 34.6) than the group A (mean = 225 ± 35.8). This difference was statistically significant ($p< 0.001$).

Conclusion: The landmark guided rectus sheath block used for midline abdominal surgeries could reduce

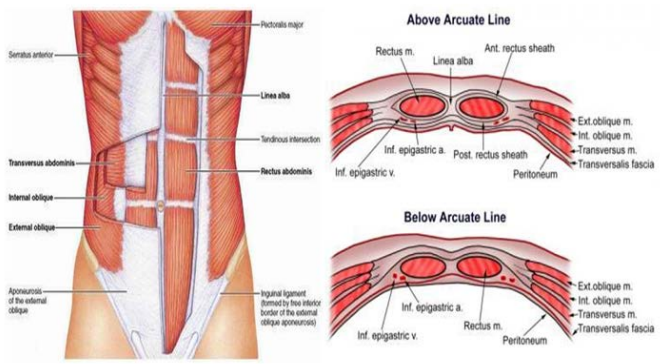
postoperative pain scores and the amount of diclofenac consumption in 24 hours postoperative period.

Keywords: Midline abdominal surgeries, landmark guided rectus sheath block, Bupivacaine

Introduction

The rectus sheath block was first described by schleich in 1899 and it was first used for abdominal wall muscle relaxation and analgesia during midline laparatomy by blocking the terminal branches of thoracolumbar nerves[1]. The central portion of the anterior abdominal wall is innervated by the ventral branches of the T7–T11 spinal nerve roots; these ventral branches lie between the rectus abdominis muscle and the posterior rectus sheath, and enter the rectus muscle near the midline[2]. As the tendinous intersections of the rectus muscle are not fused to the posterior rectus sheath, local anaesthetic from a single injection site is able to spread cephalocaudally within this compartment[3].

The rectus sheath is formed by the decussation and interweaving of the aponeuroses of the flat abdominal muscles. The external oblique aponeurosis contributes to the anterior wall of the sheath throughout its length. The superior two-thirds of the internal oblique aponeurosis splits into two layers at the lateral border of the rectus abdominis; one lamina passing anterior to the muscle and the other passing posterior to it. The anterior lamina joins the aponeurosis of the external oblique to form the anterior layer of the rectus sheath. The posterior lamina joins the aponeurosis of the transverse abdominal muscle to form the posterior layer of the rectus sheath.



Beginning at approximately one-third of the distance from the umbilicus to the pubic crest, the aponeuroses of the three flat muscles pass anterior to the rectus abdominis to form the anterior layer of the rectus sheath, leaving only the relatively thin transversalis fascia to cover the rectus abdominis posteriorly. A crescentic line, called the arcuate line, demarcates the transition between the aponeurotic posterior wall of the sheath covering the superior three quarters of the rectus and the transversalis fascia covering the inferior quarter. Throughout the length of the sheath, the fibers of the anterior and posterior layers of the sheath interlace in the anterior median line to form the complex linea alba[4].

The posterior layer of the rectus sheath is also deficient superior to the costal margin because the transverse abdominal muscle passes internal to the costal cartilages and the internal oblique attaches to the costal margin. Hence, superior to the costal margin, the rectus abdominis lies directly on the thoracic wall.

The rectus sheath block is used for analgesia after umbilical or incisional hernia repairs and supraumbilical surgical incisions. It is also used to supplement TAP block for complete analgesia following large laparotomy incision that extents from the xiphisternum to the symphysis pubis[(5,6)].

The aim of this technique is to block the terminal branches of the upper intercostal nerves (often missed by

TAP block) which run in between the internal oblique and transversus abdominis muscles to penetrate the posterior wall of the rectus abdominis muscle and end in an anterior cutaneous branch supplying the skin of the umbilical area. For this block, large amount of local anaesthetic is often required as it is mostly performed bilaterally. The technique is similar to the TAP block. The point of insertion is 2-3 cm lateral to linea alba, midway between the xiphisternum and the umbilicus . Using a short bevel or a blunt needle, once the skin barrier is breached, the needle is withdrawn and readvanced. The needle first passes through anterior rectus sheath and then through the rectus abdominis muscle till resistance is felt over the posterior wall of the rectus sheath, bouncing the needle on the fascia will confirm the correct location. Once the position is confirmed, injection of 20 ml local anaesthetic (Bupivacaine 0.25% , max dose of 3 mg/kg) is made in 5 ml aliquots. The procedure is repeated on the opposite side of the midline.

Regional analgesia techniques by blocking the nerves of the abdominal wall should be used as part of multimodal analgesia technique. Blocks on their own are insufficient as they provide analgesia of the abdominal wall (somatic) and not the abdominal viscera[7]. These blocks have an important role in decreasing analgesic requirements and can often be used even in major abdominal surgery where epidural anaesthesia may be contraindicated[8]. The use of these blocks reduces the need for strong analgesics and the associated complications like respiratory depression, itching, nausea, and vomiting. These blocks can also be employed in the critical care settings to help in weaning patients from ventilatory support[9]. The blocks described here are so simple that they can be repeated in the postoperative period either to extend the analgesia or be used as rescue for failed epidurals.

The aim of this randomized controlled double-blind study was to evaluate the analgesic effect and postoperative diclofenac consumption after bilateral landmark guided rectus sheath block as supplement to general anesthesia on adult patients undergoing midline abdominal surgeries.

Materials and methods

After the hospital ethical committee approval, 60 American Society of Anesthesiologists (ASA) physical statuses I–II patients, aged between 18–75 years scheduled for midline abdominal surgeries were included in this clinical trial.

Exclusion criteria included age < 18 years , ASA class III-IV, known allergy to paracetamol, chronic hepatic or renal failure, any contraindications to regional techniques (allergy to amide localanesthetics, infection around the site of the block, and coagulation disorder), history of analgesics dependence and patients with body mass index (BMI) >35 kg/m^2. The study was performed between September 2021 and November 2021.

All patients for midline abdominal surgeries were randomly divided in two groups, Group I (n=30) - the patients who received only general anesthesia and the group II (n=30) - the patients who receivedlandmark guided bilateral rectus sheath block and general anesthesia.

The premedication was done with midazolamam in dose of 0.02 mg/kg and glycopyrrolate 0.05mg/kg and pentazocine 30mg intravenously before surgery. Induction of general anesthesia to all 60 patients was performed with 1% propofol - 2 mg/kg . After unconsciousness and loss of eyelash reflex, succinylcholine 2mg/kg IV was injected and then Endotracheal intubation was done under direct laryngoscopy after the loss of fasciculations .Bilateral air

entry was checked, confirmed and fixed at lip level. Maintenance of anaesthesia was done with intermittent positive pressure ventilation by providing 50% oxygen and 50% nitrous oxide and sevoflurane at 1 MAC. Muscle relaxation was achieved with loading (0.5mg/kg) and maintenance dose (0.1mg/kg) of atracurium. The blood pressure was regulated in the 20% range of the preoperative blood pressure.

At the end of the surgery and before the application of sterile dressing , Rectus sheath block was given with 40 ml of 0.25% isobaric bupivacaine by inserting the 18 gauge Tuohy's needle at an angle of 60 degrees bilaterally at 11'O clock and 1'O clock position 3 to 5 cm above the umbilicus and at the lateral border of rectus abdominis under sterile aseptic precautions. First pop up was felt with Tuohy's needle while piercing the anterior rectus sheath. When the needle was advanced further, resistance had been felt against the posterior rectus sheath and drug was injected between posterior rectus sheath and rectus abdominis muscle.

Patient vitals (heart rate , blood pressure, SpO_2, ECG, $EtCO_2$) were monitored intraoperatively. Total duration of operation was noted.The postoperative pain assessment for all patients was done in the recovery room and in the surgical ward by an anesthesiologist (independent observer) at 2, 4, 6, 12, 16 and 24 hours after surgery. VNRS (0: no pain to 10: worst pain) was used for pain assessment, for which all patients received instructions before the surgery. During the first postoperative day a rescue analgesic – diclofenac 75mg I.M was applied to patients if their VNRS score was >3. Total diclofenac dose over 24 hour study period was documented. Inj. Ondansetron 4mg i.v was given as rescue antiemetic for patients who complained of postoperative nausea and vomiting.

Data analysis was performed by using Statistical Package for Social Sciences (SPSS) version 17.0 software . Data were expressed as mean ± standard deviation. Kolmogorov Smirnov test and Shapiro-Wilk's W test were used to identify the distribution of variables. Nonparametric statistical methods were used for the heterogeneous variables. The Mann –Whitney U test was used for nonparametric variables.

A P-value less than 0.05 was considered statistically significant

Results

Demographic variables and operative characteristics were similar between the groups. (Table 1) There were no statistically significant differences in age (years), BMI (kg/ m^2), operative time (minutes) and discharge time after the surgery between group I and II.

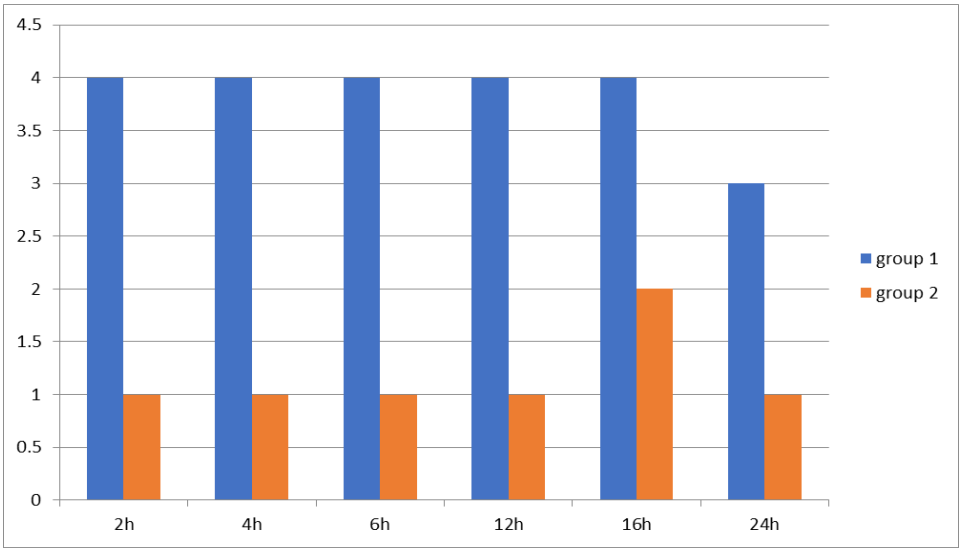
During the surgery, there were no statistically significant differences in mean blood pressure, heart rate and oxygen saturation among measurement times within both groups. There were statistically significant differences in VNRS scores between group I and groupII at all postoperative time points – 2 hr, 4 hr, 6 hr, 12 hr, 16hr and 24 hr. ($p < 0.001$). VNRS scores in group II are significantly lower (Table 2 and Figure 1).

Table 1: Demographic and clinical characteristics.

Variable	Group 1 (n=30)	Group 2 (n=30)	P- value
Age (years)	43.4+13.8	42.5+14.6	P=0.807
Sex (F/M), number	7/23	5/25	P=0.208
ASA (1/2), number	16/14	16/14	P=1.0
BMI (Kg/m^2)	24.8±4.6	25.6±4.2	P=0.485
Operative time (minutes)	46.9±10	48.5±15	P=0.629
Discharge one day after surgery (%)	n==30 (100%)	n=30 (100%)	P=1.0

Table 2: vnrs scores in group 1 and 2 at all postoperative time points

	VNRS 2h	VNRS 4h	VNRS 6h	VNRS 12h	VNRS 16h	VNRS 24h
Group 1	4±0.84					
Group 2	1±0.0 P<0.001					
Group 1		4±0.76				
Group 2		1±0.0 P<0.001				
Group 1			4±0.65			
Group 2			1±0.0 P<0.001			
Group 1				4±0.72		
Group 2				1±0.42 P<0.001		
Group 1					4±0.68	
Group 2					2±0.39 P<0.001	
Group 1						3±0.85
Group 2						1±0.0 P<0.001



Post-operative time points

Figure 1: VNRS Scores in Group 1 and 2 at all postoperative time points

Parametres	Group 1	Group 2	P Value
First demand of analgesic (in hr.)	2.2± 1.4	16±0.86	<0.001
Total amount of diclofenac consumed in 24 hr. (mg)	225±35.8	75±34.6	<0.001

The cumulative 24 hours diclofenac consumption after the operation (midline abdominal surgeries) was significantly lower in the group of patients who underwent the landmark guided rectus sheath block after general anesthesia (group II – 75± 34.6) than the group of patients who underwent only general anesthesia (group I – 225 ±35.8). This difference was statistically significant (Mann –Whitney U test: p = 0. 001).

The patients were got discharged four days after surgery and there was no complications related to rectus sheath block.

Discussion

This study has demonstrated that landmark guided rectus sheath block with general anaesthesia provides better postoperative analgesia when compared with general anaesthesia alone. Patients in whom landmark guided rectus sheath block was given had lesser VNRS scores and lesser diclofenac utilization in the first postoperative day.

Our study had few limitations. We conducted landmark guided rectus sheath block instead of ultrasound guided due to non-availability of ultrasound facility in our hospital. Secondly, we evaluated only single dose rectus sheath block but not with continuous infusion catheter due to technical difficulty and high cost.

Spread of the local anaesthetic agent in the space between the anterior layer of the rectus sheath and the rectus muscles is restricted by the presence of the tendinous intersections. There are no such intersections between the muscle and the posterior layer of the sheath. The principal determinant of spread is the volume of solution injected if the local anaesthetic agent is deposited in this layer. Advancement of the needle until the point is felt to meet the posterior layer of the rectus sheath ensures that the injection is made at the correct depth, although it should be appreciated that the resistance offered by the posterior rectus sheath is

somewhat less obvious than by the anterior layer of rectus sheath.

In a randomized, double-blind clinical trial, the effect of Bilateral Rectus Sheath Block on postoperative pain of diagnostic laparoscopy was compared with two other methods: Intraperitoneal and Intra-incisional use of local anaesthetic. Bilateral rectus sheath block has been used successfully for the repair of umbilical and paraumbilical hernias[10,11].

Compared to the transversus abdominis plane block, the rectus sheath block appears to provide denser analgesia of a shorter duration. Thus, the rectus sheath block is only useful for prolonged postoperative analgesia if continuous catheters are placed with regular dosing of local anaesthetics into the posterior rectus sheath[5].

It has been suggested that continuous indwelling rectus sheath catheter placement possesses several advantages over epidural catheter placement, which is commonly performed for postoperative analgesia. Rectus sheath block is not associated with the physiological sympathectomy which occurs with central neuraxial blockade, thus avoiding haemodynamic fluctuations commonly seen with neuraxial blockade. Unlike central neuraxial blockade, rectus sheath block is a good option in the presence of relative coagulopathy, and recent use of antiplatelets or anticoagulants[12].

Dingeman et al. found a rectus sheath block done at the end of the surgery have reduced pain scores in PACU (mean length of stay – 81 mins) , but not in the first 4 hour at home in umbilical hernia repair[13].

Elbahrawy et al. investigated the effect of rectus sheath block on postoperative VAS, and reported that average VAS scores in rectus sheath block group was significantly lower than the control group[14].

Conclusion

Landmark guided bilateral rectus sheath block with general anaesthesia has been effective in reducing the postoperative pain scores and less diclofenac utilization in midline abdominal surgeries when compared to general anaesthesia alone. Multimodal analgesia, which includes non-opioid analgesics and ambulatory continuous peripheral nerve blocks, provides effective and adequate analgesia after surgery and reduces postoperative nausea and vomiting related to consumed opioids[15].

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