

# Ultrasound guided rhomboid intercostal block: A pilot study to assess its analgesic efficacy in paediatric patients undergoing video-assisted thoracoscopy surgery

## Address for correspondence:

Dr. Chandni Sinha,  
Additional Professor,  
Department of Anaesthesia,  
AIIMS OT Complex, AIIMS,  
Patna, Bihar, India.  
E-mail: chandni.doc@gmail.  
com

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**Amarjeet Kumar, Chandni Sinha<sup>1</sup>, Poonam Kumari<sup>1</sup>, Ajeet Kumar<sup>1</sup>,  
Amit Kumar Sinha<sup>2</sup>, Bindey Kumar<sup>2</sup>**

Departments of Trauma and Emergency, <sup>1</sup>Anaesthesia and <sup>2</sup>Pediatric Surgery, AIIMS, Patna, Bihar, India

## ABSTRACT

**Background and Aims:** Ultrasound guided rhomboid intercostal plane block (RIB) is a relatively new regional anaesthesia technique that has shown to provide dermatomal coverage from T2-9 on the whole anterior and posterior hemithorax. It has proved effective in providing preemptive analgesia in various surgeries like mastectomy and thoracotomy. The aim of the study was to study the efficacy of RIB in paediatric patients: 7 to 12 years undergoing thoracoscopic surgeries in terms of analgesic requirement, pain scores and adverse effects. **Methods:** In this randomised, prospective double-blind study, 40 American Society of Anesthesiologists I/II patients, of the age group 7-12 years scheduled for Video-assisted thoracoscopy (VATS) surgery were recruited. The patients were allocated to one of the two groups: group R: general anaesthesia + RIB (RIB group) and group F: general anaesthesia (FENT group). Perioperative opioid consumption and postoperative pain scores were recorded. Adverse effects like respiratory depression and nausea were also noted. **Results:** Patients in group R required less intraoperative fentanyl dose ( $1.45 \pm 0.65$  vs  $2.90 \pm 0.45$ ) ( $P < 0.05$ ). Postoperative opioid consumption was also less in this group R ( $2.90 \pm 0.91$  vs  $5.56 \pm 1.08$ ) ( $P < 0.05$ ). Less number of patients experienced nausea (2 vs 6) and respiratory depression (2 vs 7) in group R. **Conclusion:** Ultrasound guided RIB reduces perioperative opioid consumption in patients undergoing VATS surgery with lesser postoperative pain scores.

**Key words:** Child, post operative analgesia, video-assisted thoracoscopy

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## INTRODUCTION

Video-assisted thoracoscopic surgery (VATS) has become an increasingly important and common paediatric surgical procedure. The advantages include early recovery, discharge and better cosmetic results.<sup>[1]</sup> Acute pain management becomes important to fulfil the goals of early recovery. For a long time, central neuraxial blocks were considered a gold standard in such surgeries. Over time various systemic analgesics and loco-regional analgesic/anaesthetic techniques have been used.<sup>[2]</sup> Despite this, no gold standard exists for adequate pain management in VATS.<sup>[3]</sup>

Rhomboid intercostal block (RIB) was first described by Elsharkawy *et al.*<sup>[4]</sup> in patients presenting with rib

fractures. Injection of local anaesthetic into the fascial plane between rhomboid major and intercostal muscles provided analgesia for both the anterior and posterior hemithorax. Later, this block was used successfully in surgeries like thoracotomy and modified radical mastectomy (MRM).<sup>[5,6]</sup>

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In this prospective trial, we aimed to study the efficacy of ultrasound guided RIB in patients undergoing VATS in paediatric patients. Our hypothesis was that ultrasound-guided RIB combined with general anaesthesia would decrease fentanyl consumption during the perioperative period compared with patients who received no block intervention. The primary outcome was the measurement of intraoperative fentanyl consumption and postoperative fentanyl activations in 24 hours. The secondary outcomes were postoperative pain scores and adverse effects like vomiting and respiratory depression.

## METHODS

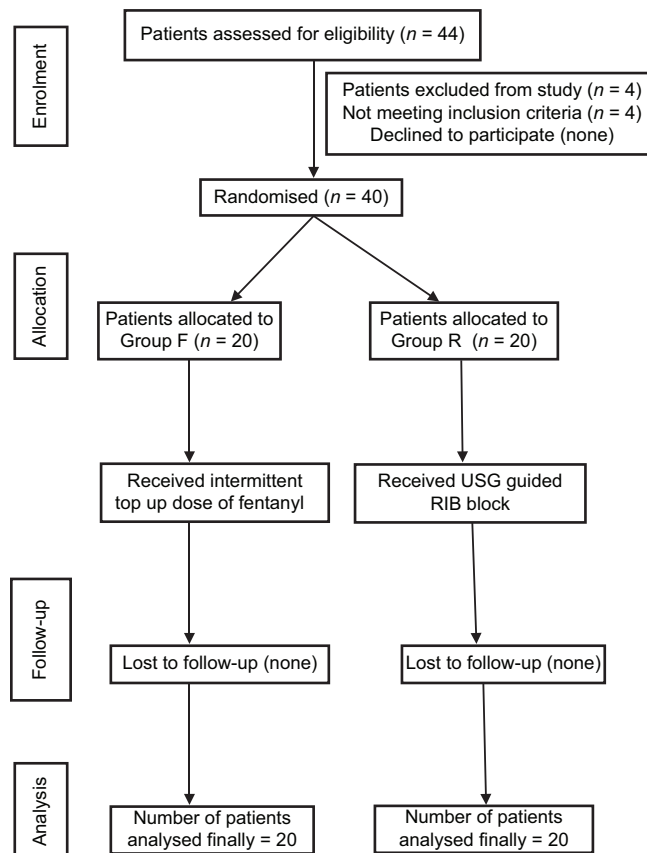
The study was designed as a prospective, randomised controlled, double-blinded trial. After taking clearance from the institutional ethical committee (IEC), Clinical Trial Registry of India (CTRI), registration was done. This study was done over a period of 14 months (November 2018 to February 2020). Forty-four consecutive paediatric patients between the age group 7 and 12 years, with American Society of Anesthesiologists (ASA) physical status I-II and scheduled for thoracoscopic surgery were screened. A total of 40 patients were enrolled for the study [Figure 1]. A written informed consent was taken from all the patients and their parents. The exclusion criteria were ASA III or more patients, patients with coagulation disorder, infection at puncture site, mental disorder, communication failure, inability to understand the functionality of patient controlled analgesia (PCA) pump and patients with known allergy to study drugs. All the patients were examined and evaluated on the day before surgery. They were educated about the use of PCA pumps.

The patients were allocated into one of the two groups by computer-generated random numbers by the primary investigator. The random allocation sequence was concealed in opaque, sealed envelopes until a group was assigned. All patients were blinded to the group allocations. Patients in group F (Fentanyl) received intermittent additional doses of fentanyl 1 µg/kg IV according to the requirement while patients in group R (RIB), received 10 ml 0.2% ropivacaine at the T6-7 level. The RIB was performed after induction of general anaesthesia, but before onset of surgery.

Intravenous access of all the patients was secured in the preoperative holding area and maintenance fluid

started. Once the patient was shifted to operating room, monitors including electrocardiography, non-invasive arterial pressure, pulse oximetry, carbon dioxide and gas analyser were attached. Anaesthesia was induced with 3 mg/kg of propofol and 1 µg/kg fentanyl I.V. Atracurium 0.5 mg/kg was given. The airway was established using appropriately sized endotracheal tube. Anaesthesia was maintained with sevoflurane in air. The attending anaesthesiologist titrated the minimum alveolar concentration of sevoflurane to maintain a Bispectral Index score (BIS) of 40 to 60.

After induction of anaesthesia, patients in the RIB group were placed in lateral position. The ipsilateral arm was moved across the chest to move the scapula away and open up the triangle of auscultation (TOA) space [Figure 2]. Rhomboid intercostal block was performed aseptically by an anaesthesiologist experienced with the performance of RIB (performed more than 20 blocks previously). A linear ultrasound transducer (M-Turbo, Fujifilm Sonosite, Inc, Bothell, WA, USA) of frequency 6–12 MHz was placed medial to the lower border of the scapula in a sagittal plane. Landmarks including trapezius muscle (TM), rhomboid major muscle (RMM), intercostal



**Figure 1:** Consort Flow Chart

muscles (ICM), rib, pleura and lung were identified. A 21-gauge, 8 cm insulated echogenic needle (Sonoplex, Pajunk, Germany) was inserted under real-time in-plane between the rhomboid major and intercostal muscles. After negative aspiration, single injection of 10 ml 0.2% ropivacaine was administered at the T6-7 level. The spread of local anaesthetic solution under the rhomboid muscle was visualised by ultrasonography. After giving the block, the anaesthesiologist who administered the block left the OR, and refrained from any contacts with the assessor. All the intraoperative assessments were made by an independent anaesthesiologist.

After a period of 20 minutes, surgery was started. An increase in 20% mean arterial pressure (MAP) (two successive readings) was treated with aliquots of 1 µg/kg fentanyl. At the end of surgery, anaesthesia was reversed and trachea extubated. All the patients were shifted to post-operative ward after confirming adequate respiration and oxygen saturation of more than 95%. Postoperatively all the patients received 15 mg/kg IV paracetamol 6<sup>th</sup> hourly. They were connected to patient controlled analgesia (PCA) pump postoperatively with the following settings: 20 µg fentanyl demand doses with a lockout interval of 10 minutes, with a maximum activation of 5 in an hour. Despite this if patient complained of pain with NRS >4, iv diclofenac 1 mg/kg was given.

Postoperatively the pain nurse, unaware of the group the patients were enrolled in, made all the assessments. Parameters assessed included: 24 hour fentanyl activations and the postoperative pain scores using NRS (0 = no pain, 10 = maximal pain) at timely intervals (1, 4, 8, 16, 24 hours). If patient had a respiratory rate of less than 12 breaths per minute, or peripheral oxygen saturation less than 90%, IV PCA was stopped. Supplemental oxygen by

face mask at 5 litres of oxygen was given. If patient experienced nausea and vomiting, 4 mg ondansetron was administered.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) 20 software. Normality of distribution was determined using the Shapiro–Wilk test. Continuous variables were analysed with unpaired t-test and categorical variables were analysed using Chi-square test. *P* value results were considered statistically significant if *P* < 0.05.

## RESULTS

A total of 40 patients were included in the study [Figure 1]. There was no statistical difference in between the two groups with respect to age, sex, weight and duration of surgery [Table 1].

The intraoperative requirement of additional aliquots of fentanyl (1 µg/kg) was more in group F ( $2.90 \pm 0.45$ ) when compared with group R ( $1.45 \pm 0.65$ ). This was statistically significant [Table 2].

The fentanyl activations required during postoperative period was more in group F ( $5.56 \pm 1.08$ ) than group R ( $2.90 \pm 0.91$ ). This differences between two groups were highly significant (*P* < 0.01). Postoperatively, pain scores were lower in patients in group R (RIB)

Table 1: Demographic characteristics

Variables	Group F (n=20)		Group R (n=20)	
	Mean	SD (±)	Mean	SD (±)
Age (year)	10.26	1.28	9.6	1.6
Weight (Kg)	34.16	3.7	35.43	5.17
Duration of surgery (mins)	93.33	15.50	89.5	21.61
Male/Female	22/8		19/11	

SD-Standard deviation

Table 2: Perioperative fentanyl consumption

Time (min)	Group F n=20		Group R n=20		<i>P</i>
	Mean	SD	Mean	SD	
Intraoperative (µg/kg)	2.90	0.45	1.45	0.65	0.0001
Postoperative (aliquot)	5.560	1.08	2.90	0.91	0.0001

SD-Standard deviation

Table 3: NRS of patients postoperatively

Time (hours)	Group F n=20		Group R n=20		<i>P</i>
	Mean	SD	Mean	SD	
1	4.36	0.365	2.80	0.87	0.0001
4	3.63	0.54	2.60	0.61	0.0001
8	3.83	0.521	2.43	0.61	0.0001
18	3.76	0.495	2.33	0.59	0.0001
24	3.3	0.45	2.1	0.30	0.0001

SD-standard deviation

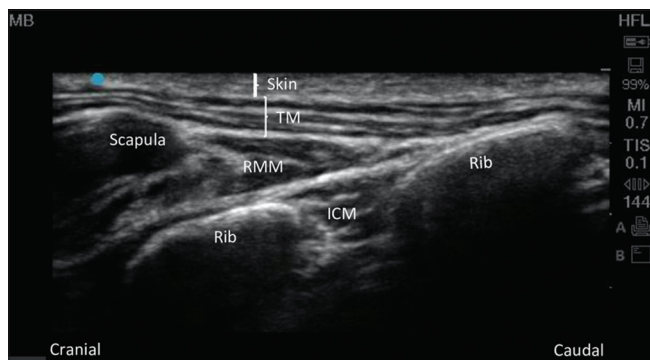


Figure 2: Sonoanatomy of triangle of auscultation: TM: Trapezius, RMM: Rhomboid major muscle, ICM: Intercostal Muscle

and the differences between two groups were highly significant ( $P < 0.01$ ) [Table 3]. Postoperative nausea was noted in seven patients in group F (FENT) when compared to two patients in group R ( $P$  value = 0.706). Two patients in group R and 6 in group F had respiratory depression ( $SPO_2 < 90\%$ ). ( $P$  value = 0.427) [Table 4]

## DISCUSSION

In the present study, ultrasound-guided RIB block significantly reduced the perioperative consumption of opioids in adolescent patients undergoing VATS surgery. The patients also reported less pain scores and less incidence of vomiting. The rhomboid intercostal block is a thoracic interfascial plane block, first described by Elsharkawy *et al.*<sup>[4]</sup> They described local anaesthetic injection in upper intercostal muscle plane and below the rhomboid muscles in the triangle of auscultation. They used it successfully in rib fracture patients wherein there was symptomatic relief. They also studied the spread of the dye in a cadaver which revealed extensive craniocaudal and anteroposterior spread.<sup>[4,7]</sup> Thereafter there were reports of using this block successfully for various surgeries: thoracotomy and modified radical mastectomy (MRM).<sup>[6-12]</sup> RIB formed a part of multimodal analgesic regime in extensive surgeries like thoracotomies.<sup>[12]</sup>

Altıparmak *et al.*<sup>[8]</sup> studied the effect of RIB on the quality of recovery and analgesia in patients undergoing MRM. Mean quality of recovery was statistically better in patients receiving the block. This was attributed to the lower opioid consumption postoperatively in this group ( $P < 0.01$ ). These results are similar to our study wherein the opioid consumption was lower in the perioperative period. The authors have also pointed out other advantages like the ease of block, sparing of long thoracic nerve (in comparison to serratus anterior plane block) and its distance from neuraxis and the surgical site. It would be especially useful in case of continuous catheter techniques where the catheter would be away from surgical field. Case reports have<sup>[6]</sup> found encouraging results of single level RIB in a woman aged 82 years scheduled for mastectomy and axillary dissection. The patient reported mild pain with no opioid requirement postoperatively. A bilevel RIB block at the T3 and T4

levels in patient undergoing MRM surgery<sup>[9]</sup> has also been reported. The patient had NRS 2–3/10 over the hemithorax in the post-operative period. Similar to previous reports, we found low pain scores at all time-points postoperatively with significantly reduced postoperative opioid consumption in patients who received RIB block.

A variation of this block has been described to be used for chest wall and upper abdominal surgery. It was named as the rhomboid intercostal and subserratus plane (RISS) block and was used in patient with aortic stenosis undergoing transapical transcatheter aortic valve implantation (TA-TAVI) under general anaesthesia.<sup>[11]</sup>

The incidence of nausea and respiratory depression is also less in patients in patients getting the block. Though this was not statistically significant, it is clinically significant. This could be explained by the less requirement of opioids in group R.

In a recent case report, erector spinae block was used successfully in a paediatric patient undergoing VATS.<sup>[13]</sup> We have not compared our block with any other locoregional technique, and this could be considered as a limitation. Other limitations include the small sample size, limited age group and inability to check the sensory blockade before the surgery. A study with a larger sample size and comparing this block with other regional techniques could be designed in future.

## CONCLUSION

In patients undergoing VATS surgery, a rhomboid interfascial plane block, leads to lower perioperative opioid consumption and significantly lower pain scores. It could form a part of multimodal analgesic regime offered to such patients.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Adverse effect	Group F n=20	Group R n=20	P
Nausea/vomiting	7	2	0.706
Respiratory depression	6	2	0.427

### Conflicts of interest

There are no conflicts of interest.

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