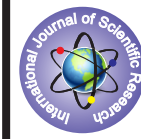


## Intercostal nerve block in Rib fracture



### Anesthesiology

**KEYWORDS:** Rib Fracture, ICNB inter costal nerve block, Analgesia, Opioids, TENS trans cutaneous nerve block

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### Introduction

Rib fracture as the most common thoracic injury in 10% of Poly trauma cases and in 40% of nonpenetrating trauma.

1. Rib fractures typically affect ribs 5-9 because the shoulder girdle affords relative protection to the upper ribs and the lower ribs lack outside structural support and are freely movable. It is usually associated with complications such as pneumothorax, hemothorax, pulmonary contusion, atelectasis, flail chest, cardiovascular injury and increase in morbidity and mortality

2. When multiple rib are fractured the pain can be severe and renders the patients unable to effectively breathe deeply, placing them at risk atelectasis and subsequently pulmonary infections. Multimodal pain control

3. With intravenous opioids, NSAID and regional nerve blocks techniques can be an effective pain control technique in these patients.

The pain associated with acute traumatic rib fractures at multiple levels can be difficult to control

4. Opioids are associated with multiple side effects including respiratory depression,

delirium, hypotension, constipation, development of tolerance and addiction. NSAIDs may be used to control pain in rib fractures but its use is restricted in patients with asthma, urticaria,

gastritis, or renal insufficiency. Both oral and intravenous route may be employed for opioid or NSAID administration in traumatic ribs fracture pain.

5. Thoracic epidural and paravertebral nerve block

6. Local anesthetic agents or in addition with the opioids is effectively used to control rib fracture pain.

7. Transcutaneous nerve block (TENS) used in rib fracture patients because of its simplicity, safety and superiority to NSAIDs, but evidence supporting its analgesic effect is limited. Intercostal block with single injection ("single shot") or with a continuous catheter

8. This technique is definitely the better choice of analgesia after thoracotomy in a patient with multiple rib fractures.

### Objectives

9. The intercostal nerves (ICN) supply major regions of the skin and musculature of the chest and abdominal wall. The intercostal nerve block (ICNB) of these nerves was first described by Braun in 1907, and later continuous ICNB was introduced in the year 1981 to overcome the problems associated with repeated multiple injections. ICNB provides superior analgesia, opioid sparing effect, improved pulmonary mechanics, reduced central nervous

depression, and no probability of urinary retention if properly performed. Advantages of the ICNB include the ability to control pain in multiple rib fractures, post herpetic neuralgia and post-operative thoracotomy and upper abdominal surgical patients. Additionally, ICNB using neurolytic agents may be used to control post-mastectomy pain. It is prudent to avoid ICNB when there is in suspicion of pneumothorax,

severe coagulopathy, local infection, and lack of expertise in regional anesthesia or unfamiliarity with the technique.

### Functional anatomy of intercostal nerve

10. Intercostal nerves are the anterior rami of the first 11 pair of thoracic spinal nerves and they lie in costal groove along with intercostal vein and artery. Each intercostal nerve has four branches: the gray ramus communicans, which passes anterior to the sympathetic ganglion; the posterior cutaneous branch, which supplies the skin and muscle in the paravertebral area; the lateral cutaneous branch, which arises just anterior to the midaxillary line and sends subcutaneous branches anteriorly and posteriorly; and the anterior cutaneous branch, which is the termination of the nerve.

### Techniques of intercostal nerve block

11. Prior to initiating an intercostal nerve block, the patient's airway and breathing must first be assessed and adequately monitored with an available oxygen supply. An intravenous line and resuscitation drugs should be immediately available and systemic sedation and analgesia may be required for the patient to tolerate the procedure. ICNB can be performed with the patient in the prone, sitting, or lateral position. In order to utilize the prone position for ICNB, a pillow is placed under the abdomen in order to reduce the lumbar curve. Next, parallel lines are drawn along the posterior angles of the rib, which can be palpated 6 to 8 cm from the midline.

The inferior edge of each rib is palpated and marked on a line intersecting the posterior angle of the rib. After appropriate skin preparation, local anesthetic is infiltrated using a 22-gauge, short-beveled 4-cm needle (which may be attached to a syringe); this needle is inserted until it rests on the rib, and then is slowly walked 3 to 5 mm off of the lower rib edge, where 3 to 5 mL of local anesthetic is injected. This process is repeated at each rib as clinically indicated. ICNB may also be performed in a supine position and in lateral position.

ICNB may cause complications like pneumothorax, hemothorax, local anesthetic toxicity, hematoma, nerve damage, and spinal anesthesia.

12. Recently, ultrasound Fluoroscopy guided ICNB has been demonstrated as imaging techniques that can be safely incorporated to prevent the serious complications of intravascular local anesthetic administration, along with observing the spread so that the direction and depth of needle can be adjusted to provide optimal analgesia before administering the entire local anesthetic dose.

### Choice of Local Anesthetics

13. Local anesthetic options for single shot ICNB include bupivacaine 0.25-0.5%, lidocaine 1-2% with epinephrine 1/200,000-1/400,000 and ropivacaine 0.5-0.75%. 3-5 mL of local anesthetic is injected at each level during a multiple injection ICNB technique. The duration of action is usually  $12 \pm 6$  hours. While the addition of epinephrine to bupivacaine or ropivacaine does not significantly prolong the duration of block, it may slow the systemic absorption and increase the maximum allowable dose with a single shot by 30%. The maximum bupivacaine dose is 2 mg/kg actual body weight (ABW) for plain solution and 3 mg/kg with epinephrine.

The maximum dosage for ropivacaine plain solution is 2.5 mg/kg and 4 mg/kg with epinephrine.

Intercostal injection of dexamethasone containing bupivacaine microcapsules may be used as good adjuvants to produce a prolonged duration of anesthesia and analgesia.

### REFERENCES

14. Matsota et al compared the analgesics effect of intercostals nerve block of 0.5% bupivacaine with epinephrine and pethidine in 20 children who undergone thoracotomy and they found the duration of analgesia was longer with ICNB in bupivacaine group whereas the incidence of nausea and vomiting was higher in the pethidine group.
15. Ouerghi et al studied the effect of continuous ICNB versus paravertebral block in 46 adult patients who have undergone thoracotomy. Pain at rest was similar in both groups but on coughing the pain scores was lower in paravertebral block group at 42 and 48 hours. The authors concluded that both blocks are safe and provide effective pain relief following thoracotomy.
16. In 2011, Ho et al published a review article focusing on regional techniques for pain control in multiple rib fractures and he concluded thoracic epidural, paravertebral or intercostal blocks have equal benefit in the pain management of multiple rib fractures, although the authors expressed a preference for paravertebral blocks.
17. Osinowo noticed the effect of 0.5% bupivacaine in 21 adult patients with rib fractures and they noticed significant improvement in oxygen saturation ( $\text{SaO}_2$ ), peak expiratory flow rate (PEFR) with improvement in respiratory functions and analgesia.
18. Chaudary et al reported the effect of parasternal ICNB with ropivacaine in 30 children who undergone cardiac surgery, the pain score was less in ropivacaine group in comparison to saline group whereas the requirement of fentanyl was higher in saline group.
19. Kapocz et al studied the pharmacokinetics of ropivacaine and bupivacaine in 12 healthy volunteers for bilateral intercostals nerve block and they concluded that 0.25% ropivacaine without the addition of epinephrine or sedation can be safely used.