

# Intercostal Nerve Block

The intercostal nerves supply the major parts of the skin and musculature of the chest and abdominal wall. Few surgical procedures can be performed with an intercostal block alone, and application of these blocks in combination with other techniques has largely been supplanted by epidural blockade. Although surgical applications are possible, the majority of indications are for postoperative analgesia. Supplemental systemic analgesia is always needed.

## INDICATIONS

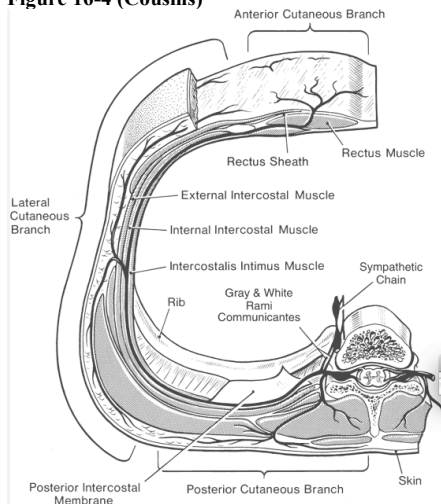
- Analgesia for chest trauma such as rib fractures and for after chest and upper abdominal surgery such as thoractomy, thoracostomy, mastectomy, gastrostomy, and cholecystectomy
- For acute and chronic pain conditions affecting the thorax and upper abdomen
- Can be used in combination with celiac plexus or splanchnic nerve blockade (intercostal nerve block does not block visceral abdominal pain) and light general anesthesia for intra-abdominal procedures
- Can be used in combination with stellate ganglion blocks and sedation for intrathoracic surgery

## CONTRAINDICATIONS

- **ABSOLUTE**
  - Patient refusal
  - Inability of patient to cooperate and remain still during procedure
- **RELATIVE**
  - Coagulopathy
  - Infection at site of insertion
  - When pneumothorax would be a disaster

## ANATOMY

Figure 16-4 (Cousins)



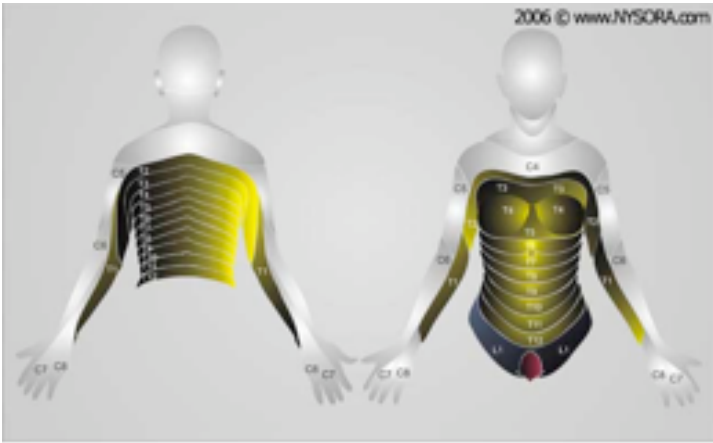
- The intercostal nerves are the primary rami of T1 through T11
- T12 is technically a subcostal nerve and supplies branches to the ilioinguinal and iliohypogastric nerves
- Carrying both sensory and motor fibers, the intercostal nerve pierces the posterior intercostal membrane about 3 cm (in adults) distal to the intervertebral foramen to enter the subcostal groove where it continues to run parallel to the rib, although branches may often be found anywhere between adjacent ribs
  - Intercostal nerve block blocks the ipsilateral sensory and motor fibers of the intercostal nerves by a direct effect of the local anesthetic
- Medial to the posterior angles of the ribs, the intercostal nerves lie between the pleura and the internal intercostal fascia
- At the posterior angle of the rib, the nerve lies in the costal groove accompanied by the intercostal vein and artery
- Each intercostal nerve has four branches:
  1. Gray ramus communicans, which passes anterior to the sympathetic ganglion
  2. Posterior cutaneous branch, which supplies the skin and muscle in the paravertebral area
  3. Lateral cutaneous branch, which arises just anterior to the midaxillary line and sends subcutaneous branches anteriorly and posteriorly
  4. Anterior cutaneous branch, which is the termination of the nerve

## LANDMARKS

- Blockade of two dermatomes above and two below the level of surgical incision is required
- The intercostal nerve can be blocked anywhere proximal to the mid-axillary line, where the lateral cutaneous branch originates
- The most popular site in adults is at the angle of the rib, 6-8 cm from the spinous processes
  - At the angle of the rib the rib is relatively superficial and easy to palpate and the subcostal groove is the widest, theoretically reducing the probability of pleural puncture
  - Within this groove, the nerve is inferior to the posterior intercostal artery, which is inferior to the intercostal vein
  - The vein, artery and nerve are surrounded mainly by adipose tissue and are sandwiched between the internal intercostals muscle and the interior intercostal muscle
  - The nerve often runs as three or four separate bundles, without an enclosing endoneural sheath, making it easily accessible to blockade

## DISTRIBUTION OF ANESTHESIA

- Fibers from T1 contribute to the brachial plexus
- T2 and T3 provide a few fibers to formation of the intercostobrachial nerve, which supplies the skin of the medial aspect of the upper part of the arm
- T3 to T6 supply the thorax
- T7 to T11 supply the lower thorax and abdomen
- T12 innervates the abdominal wall and the skin of the front part of the gluteal region

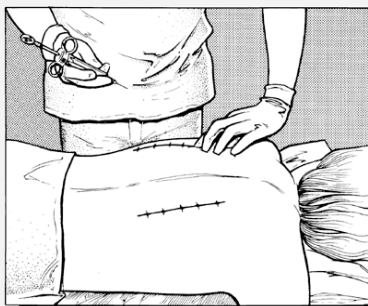


#### EQUIPMENT

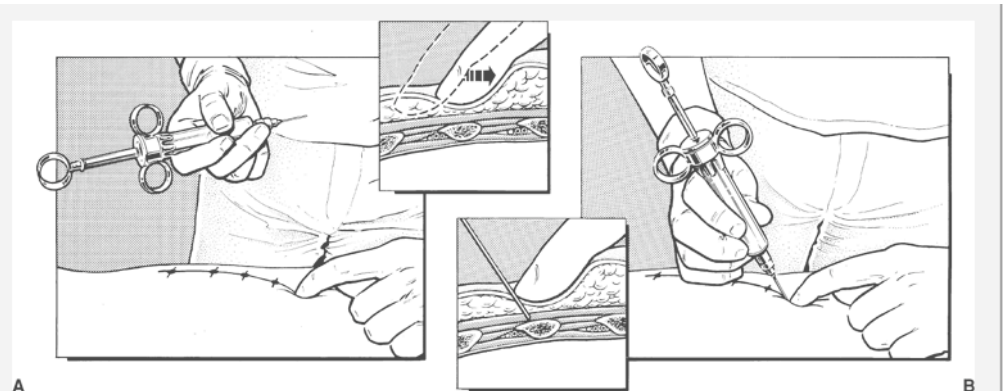
- Needle:
  - Single-shot: 20-22 gauge short beveled 4-5 cm needle (adults)
  - Catheter placement: 18-20 gauge Tuohy needle (adults)
- Syringe and needle for local infiltration
- Syringe with extension tubing
- Sterilizing and resuscitation equipment and drugs, drapes, marking pen, pillow, portable fluoroscope (for neurolytic blocks)

#### TECHNIQUE

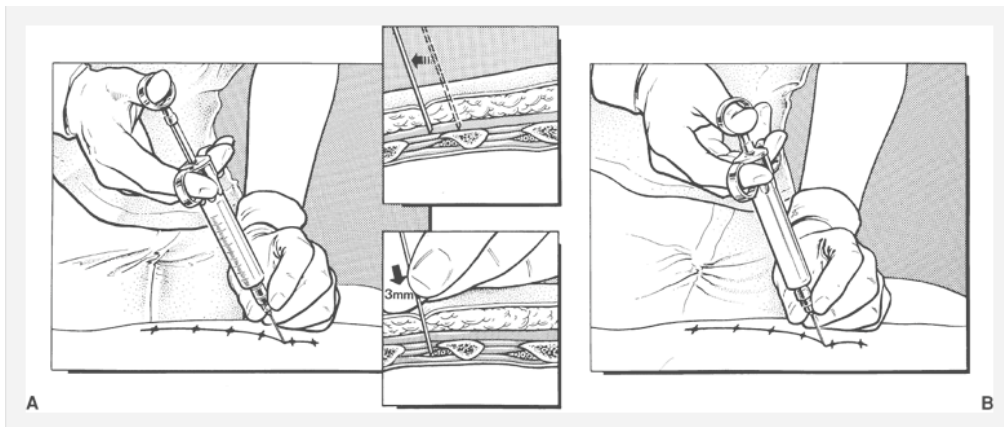
- Intercostal nerve blocks can be done percutaneously or under direct vision when the chest is open
- The duration of analgesia is limited to the duration of action of the local anesthetic used and the blocks will need to be repeated to have any useful effect on postoperative lung function
- Patient can be prone (pillow under abdomen), sitting (leaning forward), or lateral (block side up)
- Count ribs if required (7<sup>th</sup> rib is the lowest rib covered by the inferior tip of the scapula)
- Mark the inferior edges of the ribs to be block just lateral to the lateral border of the sacrospinalis (paraspinous) muscle group (usually 6-8 cm from the midline at the lower ribs and 4-7 cm from the midline at the upper ribs) corresponding to the angles of the ribs
- Infiltrate the sites of skin entry with a small volume of lidocaine 1-2%
- Draw the skin cephalad with the palpating hand by about one cm, and a 4-5 cm 22-gauge to 24-gauge (for single-shot injection) short-bevel needle is introduced through the chosen site of entry at a 20 degree cephalad angle and with the bevel facing cephalad
- The needle is advanced until it contacts the rib at a depth of less than 1 cm for most non-obese patients
- With the palpating hand holding the needle firmly and resting securely on the patient's back, the injecting hand gently walks the needle caudally while the skin is allowed to move back over the rib
- The needle is now advanced 3 mm, still maintaining the 20-degree tilt angle cephalad (even a slight caudad pointing angle by the needle greatly reduces the chance of success)
- A subtle give or pop of the fascia of the internal intercostal muscle may be felt, especially if a short-bevel needle is used
- As the average distance from the posterior aspect of the rib to the pleura averages 8 mm, advancement of the needle much beyond 3 mm increases the risk of pneumothorax
- Paresthesia (not actively sought) confirms needle placement
- Aspirate for blood, if negative, inject 3-5 mL of local anesthetic (bupivacaine 0.25-0.5%, lidocaine 1-2% with epi 1/200,000-1/400,000, and ropivacaine 0.5-0.75%)
- Total bupivacaine dose for a single session of blocks should not exceed 1 mg/kg
- For a single intercostal nerve block, it is desirable to block at least one intercostal nerve cephalad and one caudad as some degree of overlapping innervation from adjacent intercostal nerves is common
- Indwelling intercostal catheters are an option, but they can be difficult to position reliably percutaneously.



**Figure 16-6.** Technique for intercostal block and corresponding deep anatomy. Skin markings at lateral edge of sacrospinalis muscle (6-8 cm from midline). Note the medial curve of the line superiorly to avoid the scapulae. Ribs and interspaces are palpated. The lowest (most inferior) intercostal nerve is blocked first because the lower ribs are easy to palpate.



**Figure 16-7. A:** Skin at lower edge of rib retracted superiorly onto rib. **B:** Needle inserted onto rib (see also inset). Note finger palpating rib still in place and hand holding syringe firmly braced against back.



**Figure 16-8. A:** The position of the hands now change. Note left hand now rests against the back and holds the needle as it is walked off the inferior edge of the rib and advanced 3 mm. Right hand is free to aspirate and inject. **B:** Injection completed with left hand still firmly against patient's back and controlling the needle.

### **Interpleural Catheter**

- The technique for interpleural catheter placement is quite simple and can be performed with the patient in a lateral (and slightly oblique) or sitting position
- The sixth or seventh intercostal space is identified, and the needle is inserted about 10 cm lateral to the posterior midline, and an epidural needle tip is advanced until it rests on the cephalad edge of the rib below the **intercostal** space to be entered
- A glass syringe filled with saline or air is then attached to the needle, and the unit is advanced slowly over the superior edge of the rib
- When the tip of the needle enters the parietal pleura, the solution in the syringe is drawn into the chest cavity because of the negative intrathoracic pressure; This effect can be observed in mechanically and in spontaneously ventilating patients, but it is accentuated in the latter group
- The catheter is then inserted approximately 5 to 8 cm into the interpleural space and secured on the chest wall
- During needle positioning and catheter placement, care must be taken to minimize entrainment of air through the needle
- Lung parenchymal damage can occur with loss-of-resistance techniques or insertion of excessive lengths of catheter

### **COMPLICATIONS**

- Pneumothorax – Incidence 1.4% for each intercostal block, 5.6% when multiple intercostal blocks are performed
- Intravascular injection – the intercostal vessels are adjacent to the nerve in the groove
- Local anesthetic toxicity – absorption of local anesthetic from the intercostal space is rapid and blood levels of local anesthetics after intercostal nerve blocks are higher than any other regional anesthetic procedure
- Intrapulmonary injection with consequent bronchospasm
- Neuraxial spread, spinal anesthesia
- Hematoma
- Nerve damage
- Infection
- Multiple intercostal blocks nerve blocks for rib fractures also predispose to a higher incidence of pneumothorax
- Patients should be monitored and observed carefully for at least 20 to 30 minutes after the block
- Patients with severe pulmonary disease who rely on their intercostal muscles may exhibit respiratory decompensation after bilateral intercostal blockade

### **REFERENCES**

- NYSORA website
- Miller Chpt 52
- Cousins P. 385-390, 525, 1240