



# Intercostal Nerve Block with Ultrasound

# 16

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## Abstract

The intercostal nerves provide sensory and motor innervation for much of the back, trunk, and abdominal wall. Each intercostal nerve travels within a neurovascular bundle made up of an intercostal nerve, artery, and vein. This bundle runs along the costal groove at the inferior edge of its accompanying rib. The intercostal nerve lies inferior to both vessels within the neurovascular bundle. The proximity of the nerve to the vessels accounts for the high uptake of local anesthetic into the blood.

Each intercostal nerve originates from the spinal nerve root at the vertebral level of the rib it travels with. Spinal nerves divide into dorsal and ventral branches, with the ventral branches continuing anterolaterally to become the intercostal nerves. The intercostal nerve briefly travels between the parietal pleura and innermost intercostal muscle before continuing anterolaterally between the internal and innermost intercostal muscles. As the intercostal nerve travels towards the midaxillary line the lateral cutaneous branch splits off—traversing the internal and external intercostal muscles and dividing into an anterior and posterior branch which supply the lateral trunk. As the intercostal nerve travels anteriorly it forms another branch called the anterior cutaneous branch that divides into the medial and lateral branches which supply the anterior trunk and abdomen.

Intercostal nerve blocks are indicated as primary or adjunct pain management intervention for patients with rib fractures or chest wall and upper abdominal pain. Indications include thoracic surgery incisional pain, post-thoracotomy pain,

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herpes zoster or post herpetic neuralgia, postmastectomy pain, and cholecystectomy. Contraindications are patient refusal, active infection over the injection site, and occasionally coagulation disorders.

Complications arise due to the proximity of the intercostal nerves to the lung and intercostal vasculature. These include pneumothorax, hemothorax, local anesthetic systemic toxicity, and even risk of spinal blockade (Chaudhri et al., *Ann Thorac Surg* 88(1):283–284, 2009; Shanti et al., *J Trauma* 51(3):536–539, 2001).

Intercostal nerve blocks can be performed with a landmark technique or under ultrasound or fluoroscopic guidance. Though efficacy and complication rates are similar between ultrasound and fluoroscopic guidance, ultrasound carries the advantage of better visualization of vascular structures, real time visualization of the pleura, and avoids the need for contrast or radiation exposure (Elkhashab and Wang, *Curr Pain Headache Rep* 25(10):67, 2021).

### Keys to Procedure

- Identify the dermatomal distribution required to cover the intended area of analgesia.
- Locate the correct rib associated with the target dermatome.
- Understand proper patient positioning with the scapula pulled laterally to optimize access to posterior rib angles.
- Blockade of at least one dermatome above and below the level of surgical incision is required.
- Understand the complications and corrective steps if encountered.

### What You Will Need

- Sterile towels or drape
- Chlorhexidine-based soap
- Ultrasound with linear transducer
- Sterile probe cover
- Sterile ultrasound gel
- 25G 3.5" spinal needle
- 25G 1.5" needle for skin local
- 18G 1.5" needle to draw up medications
- Bupivacaine 0.5%—4 ml (for two level block)
- Dexamethasone 10 mg—1 mL
- 5 mL syringe for injectate (4 mL Bupivacaine 0.25%/0.5% + Dexamethasone 10 mg).

### Patient Positioning

- Prone with arms extended overhead.
- Scapula pulled laterally to optimize access to posterior rib angles.

## How to Perform the Procedure

Mark site of most severe pain to identify appropriate ribs and intercostal nerves to block.

Sterilely prep over target thoracic area and drape with sterile towels.

Place the ultrasound probe in the sagittal plane approximately 4 cm lateral to the spinous process to identify the target intercostal nerve.

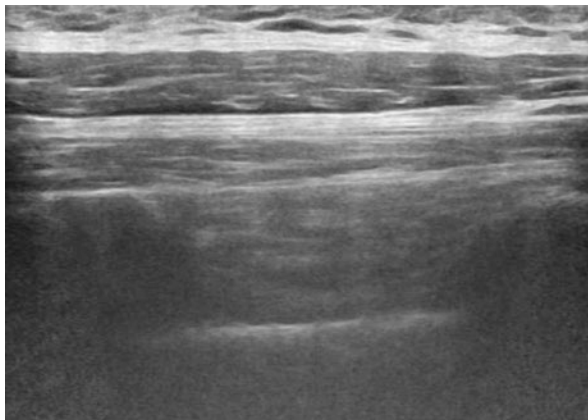
Intercostal nerve runs inferior to the rib within the neurovascular bundle (Image 16.1).

Position linear transducer with the inferior aspect of the target rib level cephalad and the superior aspect of the rib one level below caudad.

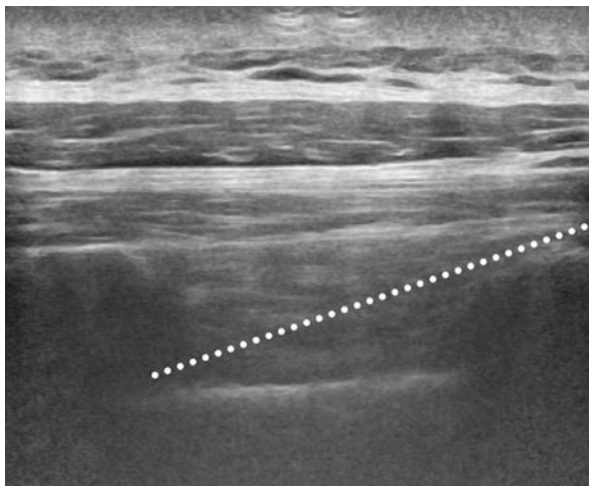
Make sure to visualize the intercostal muscles and parietal pleura at the desired level.

Insert the 25G spinal needle caudal to the target, advancing caudal to cranial in-plane to target the intercostal nerve while remaining superficial to the parietal pleura (Image 16.2).

**Image 16.1** Ultrasound image of ribs and pleura



**Image 16.2** Ultrasound image of the suggested needle trajectory to target the intercostal nerve (right = inferior, left = superior)



Aspirate and administer 2.5 mL of injectate (4 mL Bupivacaine + Methylprednisolone 40 mg) slowly.  
Repeat Steps 3–6 for each desired level.  
Remove needle, clean site, and place adhesive dressing.

## Checkpoints to Mastery

### Beginner

- Identify the dermatome(s) associated with the patient's pain.
- Mark the correct rib(s) corresponding with the desired dermatomes to be blocked.
- Position the ultrasound and identify the desired target rib, intercostal muscles, and parietal pleura.

### Intermediate

- Localize the skin while holding a consistent image with the ultrasound.
- Insert spinal needle and demonstrate in-plane needle visualization in the subcutaneous tissue prior to advancing through the intercostal muscles.

### Advanced

- Advance the needle through the intercostal muscles to the desired target while maintaining in-line needle visualization.

### **Pitt Pain Pearls and Pitfalls**

- Avoid entering the parietal pleura and causing a pneumothorax. The consent process should mention complications such as pneumothorax.
- If visualization of the needle tip is difficult because of body habitus and/or angle of needle trajectory, switch to curvilinear probe or fluoroscopy.
- Target posterior to the posterior axillary line to ensure block of the entire intercostal nerve territory. The intercostal nerve branches at the level of the posterior axillary line, dividing into main and collateral branches. At the mid-axillary line it branches a second time, with the lateral cutaneous branch traveling laterally to innervate the skin and subcutaneous tissue of the lateral trunk and upper abdomen.
- You can use ultrasound doppler to identify the intercostal neurovascular bundle prior to inserting the needle for the injection.

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### **References**

1. Chaudhri BB, Macfie A, Kirk AJ. Inadvertent total spinal anesthesia after intercostal nerve block placement during lung resection. *Ann Thorac Surg.* 2009;88(1):283–4. <https://doi.org/10.1016/j.athoracsur.2008.09.070>.
2. Shanti CM, Carlin AM, Tyburski JG. Incidence of pneumothorax from intercostal nerve block for analgesia in rib fractures. *J Trauma.* 2001;51(3):536–9. <https://doi.org/10.1097/00005373-200109000-00019>.
3. Elkhatab Y, Wang D. A review of techniques of intercostal nerve blocks. *Curr Pain Headache Rep.* 2021;25(10):67. <https://doi.org/10.1007/s11916-021-00975-y>.

### **Further Reading**

Intercostal Nerve Block. USRA. <http://www.usra.ca/pain-medicine/specific-blocks/trunk/intercostal.php>.