PROCEDURES PRO

INTERCOSTAL BLOCKS FOR RIB FRACTURES

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Local analgesic techniques—including intercostal, epidural, and spinal blocks—are frequently used to treat pain related to thoracic surgery or trauma (eg, rib fractures).[1]

Pain associated with thoracic trauma, whether surgically induced or traumatic in origin, can lead to hypoventilation, delayed recovery, increased morbidity, and prolonged hospitalization.[1,2] Local anesthesia at the level of the intercostal spaces provides benefits over thoracic epidural anesthesia by inducing less sympathetic blockade, addressing pain closer to the initiation of the pain pathway, and providing complete blockade of all pain fibers, with minimal effect on ventilation.[3] Intercostal nerve blocks have been shown to improve pulmonary function in the postoperative period in human and veterinary patients undergoing thoracotomy[4-6]; in addition, in humans, intercostal nerve blocks used to treat multiple rib fractures have been shown to be effective and to decrease the amount of systemic opioid needed to control pain.[5] Dogs and cats with multiple rib fractures are at risk for decreased pulmonary function and may require high rates of systemic analgesics to control pain.[7]

Relevant Anatomy

The paravertebral space involves the spinal nerve root, which is continuous with the intercostal nerve. This space is not completely segregated; drugs injected into one specific paravertebral space have the potential to spread cranially and caudally into additional paravertebral spaces, as well as medially and laterally into the epidural and intercostal spaces. The intercostal space is continuous

TABLE

LOCAL PERINEURAL ANESTHETIC DOSAGES[1-3]

Drug (Concentration)*	Duration of Action**	Dose (Dogs)	Maximum Dose (Dogs)	Dose (Cats)	Maximum Dose (Cats)
Bupivacaine (0.5% or 0.25%)	4-12 hr (average, ≈6-8 hr)	0.5-1 mg/kg	2 mg/kg	0.25-0.50 mg/kg	1 mg/kg
Lidocaine (2%)	1-2 hr (average, ≈90 min)	1-2 mg/kg	5-6 mg/kg	0.5-1 mg/kg Note: Systemic uptake should be avoided by ensuring the block does not go intravenously	1-2 mg/kg
Morphine (10 mg/mL or 25 mg/mL)	4-6 hr	0.1 mg/kg		0.1 mg/kg	
Methadone (10 mg/mL)	4-6 hr	0.1 mg/kg		0.1 mg/kg	
Dexmedetomidine (0.5 mg/mL)	4-6 hr	1-2 µg/kg		1-2 µg/kg	

* Onset of local analgesia can take up to 20 minutes but depends on the drug(s) used. Rapid-onset drugs (eg, lidocaine, α_2 agonists) can be added to those with slower onset (eg, bupivacaine, opioids) to facilitate a faster onset of analgesia.
** The duration of the block itself is altered by the agents and dose selected for each patient.

with the paravertebral space and involves the nerve roots that branch from the paravertebral nerve and supply the ribs, intercostal muscles, and skin. In general, the neurovascular structures that line the thoracic cavity have both cranial and caudal branches, which divide and supply the skin and intercostal muscles of segments adjacent to that paravertebral space.

Due to this collateral circulation/innervation, blocking sites adjacent to rib fractures is recommended to ensure appropriate analgesia to the intended site. Risks associated with this procedure include iatrogenic pneumothorax, intraneural or intravascular injection, systemic toxicity of local anesthetics, and, rarely, introduction of bacteria into the intercostal or paravertebral space.

Agents for Intercostal Blocks

Drugs used in intercostal blocks can include local anesthetics, opioids, or α_2 agonists; a combination of drugs is often recommended to increase effects on the pain pathway.[1,2,5,8] Bupivacaine, a local anesthetic that provides long-term pain relief, is often recommended because it provides 6 to 8 hours of blockade.[9] Mixing bupivacaine with either an opioid (eg, preservative-free morphine) or an α_2 agonist (eg, dexmedetomidine) can provide additional analgesia by activating local opioid and α_2 receptors and through systemic absorption.[10] A study in humans noted that the risk for local anesthetic toxicity is highest when local anesthetics are administered at the paravertebral space, and another noted that local anesthetics are also rapidly absorbed from the intercostal space.[9]

Care should be taken when calculating drug dosages (***Table***), and the effects of systemic absorption of local anesthetics and adjunctive agents should be considered.[9] If there are multiple rib fracture sites and more volume is needed to appropriately block all ribs, decreasing the dose of bupivacaine and adding lidocaine to increase the volume is ideal; however, this will decrease the overall duration of action. Adding sterile water (or saline) to the volume of local anesthetic may also be appropriate. After the number of fractured ribs is determined, the number of sites to block and the number of aliquots of local anesthetic to prepare should be calculated (see ***Calculating Intercostal Sites***). If multiple ribs are broken on one side, many of these sites will overlap cranially and caudally.

CALCULATING INTERCOSTAL SITES

Fracture Site (rib #) = 7
Cranial Intercostal Spaces: 5-6, 6-7
Affected Space: 7-8
Caudal Intercostal Spaces: 8-9, 9-10
Total Spaces to Block: 5

Fracture Site (rib #) = 4, 6
Cranial Intercostal Spaces: 2-3, 3-4; 4-5, 5-6
Affected Spaces: 4-5, 6-7
Caudal Intercostal Spaces: 5-6, 6-7; 7-8, 8-9
Total Spaces to Block: 8 (Note: Several of these spaces overlap between the 2 fracture sites.)

Blocking sites adjacent to rib fractures is recommended to ensure appropriate analgesia to the intended site.

WHAT YOU WILL NEED

- Clippers and preparation supplies (eg, chlorhexidine scrub, alcohol)
- Gloves
- Selected drugs divided into aliquots based on number of sites to block (see ***Calculating Intercostal Sites***, previous page)
- Aliquots of sterile saline
- New spinal or hypodermic needle (22-25 g) for each site

STEP-BY-STEP INTERCOSTAL BLOCKS FOR RIB FRACTURES

STEP 1

Sedate (or anesthetize, if needed) the patient using an opioid and either a benzodiazepine or an α_2 agonist, depending on the patient's overall cardiovascular and systemic health status.[11]

Author Insight

If the patient has suffered fractures due to trauma, electrocardiography and close monitoring should be instituted to observe for evidence of cardiac contusions in the form of arrhythmias. The presence of arrhythmias may change the drug choice for sedation, general anesthesia, and/or paravertebral local blocks.

STEP 2

Obtain thoracic radiographs to confirm the location of the broken rib(s).

STEP 3

Block at least 2 intercostal spaces cranial to and caudal to the fracture on the ipsilateral side to deliver complete analgesia to the fracture site (see ***Calculating Intercostal Sites***, previous page). Count sites multiple times to ensure the appropriate spaces are blocked. While wearing gloves, clip long hair at the injection site if needed for accurate palpation, and clear the site of debris and obvious contamination.

STEP 4

Place the patient in lateral recumbency with the injured side up, and ensure supplemental oxygen is being provided. Insert a small (<22-gauge) spinal needle as dorsally as possible (near the intervertebral foramen) at the very caudal border of the rib cranial to the desired intercostal space.

Author Insight

Mask oxygen is considered adequate if the patient is not receiving additional support (eg, nasal cannulas). If the patient already has a nasal cannula, this is preferred over a mask but does not need to be placed solely for this procedure.

STEP 5

Walk off the rib surface in a caudal direction, then aspirate with a syringe containing a small amount of sterile saline to confirm that the needle is not in a vessel or in the thoracic cavity.

Author Insight

Imaging (eg, ultrasonography, fluoroscopy) can help indicate the correct location.

STEP 6

Inject a small amount of sterile saline. If there is no resistance, disconnect this syringe and connect the syringe of local anesthetic; if resistance is encountered, carefully redirect the needle, using caution not to enter the thoracic cavity. Slowly inject the total volume for the site over 2 minutes. Repeat the process for each additional site. Monitor the patient for changes in respiratory rate/character or signs of respiratory distress that may be indicative of a pneumothorax.

STEP 7

Continue with supplemental oxygen, and perform thoracocentesis if pneumothorax is suspected.

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