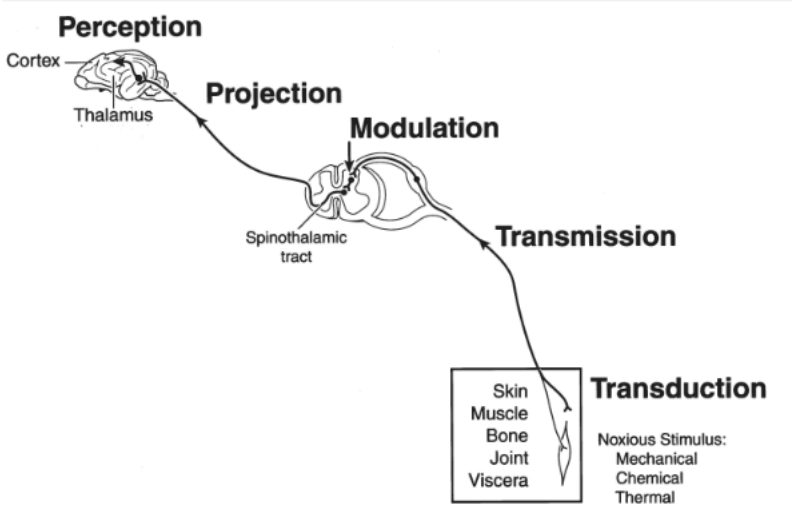
LOCAL ANESTHETICS AND REGIONAL TECHNIQUES

Carissa Tong, BVM&S

Local anesthetics (LAs)

- Reversibly blocks the generation (transduction) and propagation of electrical impulses (transmission) → sensory and motor blockade

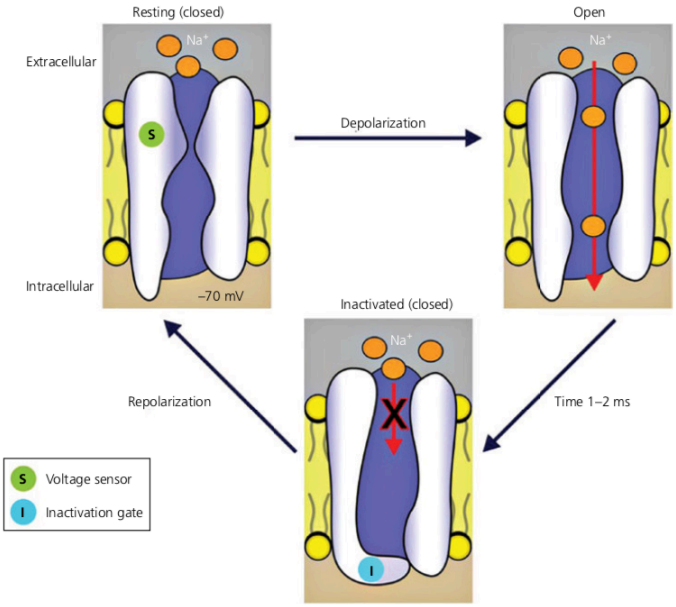


Mechanism of Action

- Ion channel blockers (voltage-gated Na+ >>> K+, Ca2+ channels)
- Anesthesia via blockade of inward Na+ currents through voltage-gated channels → impedes membrane depolarization, nerve excitation and conduction
- Na+ channel: multimolecular complex
    - Large alpha-subunit composed to 2k amino acids = channel pore and gating apparatus
        - DIV S6 segment is the binding site for local anesthetic, antiarrhythmic and anticonvulsant drugs
        - Only accessible from the intracellular side
    - Beta-subunit influence activation-inactivation state

Sodium channel:

- Has two gates: an activation ('voltage sensor') and an inactivation gate
- Resting membrane potential: channel in resting (closed state)
- Depolarization of the membrane is sensed by voltage sensor → channel opens and allows Na+ ions to flow intracellularly
- Within 1-2 minutes, the inactivation gates closes automatically → repolarization starts
- Repolarization leads to conformational change w/ closure of the activation gate and opening of the inactivation gate w/in 2-5 ms (refractory period)
- After repolarization, the channel is in a resting state again.



How do they block?

- LAs block nerve conduction in **all types of neurons**
  - All pain (A delta and C fibres), sensory, motor, proprioceptive and sympathetic nerve fibres
- Minimum concentration needed to block conduction is higher in motor than sensory fibres
- Order of block:
  - 1st: Autonomic preganglionic B fibers
  - 2nd: A delta and C sensory fibres at lower concentration than large sensory A beta, motor A alpha, and proprioceptive A gamma fibres

Types of Neurons Blocked with Local Anesthetics*

Neuron Type	Function	Myelination	Order of Blockade	Signs of Blockade
A alpha	Motor—skeletal muscle	Myelinated	Fifth	Loss of motor function
A beta	Sensory—touch, pressure	Myelinated	Fourth	Loss of sensation to touch and pressure
A gamma	Motor—muscle spindles; proprioception	Myelinated	Third	Loss of proprioception
A delta	Fast pain, temperature	Myelinated	Second	Pain relief, loss of temperature sensation
B	Autonomic, preganglionic sympathetic	Myelinated	First	Increased skin temperature
C	Slow pain, postganglionic sympathetic, polymodal nociceptors	Unmyelinated	Second	Pain relief, loss of temperature sensation

Physiochemical properties

- LAs consist of a lipophilic and a hydrophilic portion separated by a connecting hydrocarbon chain
- Either has an ester (-CO) or an amide (-NHC-) bond linking the hydrocarbon chain to the lipophilic aromatic ring
    - Nature of this bond is the basis for classifying drugs that produce conduction blockade of nerve impulses as either ester LAs or amide LAs
    - Ester: procaine, cocaine, chloroprocaine, tetracaine
    - Amides: lidocaine, bupivacaine
- Hydrophilic group is usually a tertiary amine (e.g. diethylamine) whereas the lipophilic portion is usually an aromatic ring (e.g. para-aminobenzoic acid)

Figure 1. Chemical structure of local anesthetics.

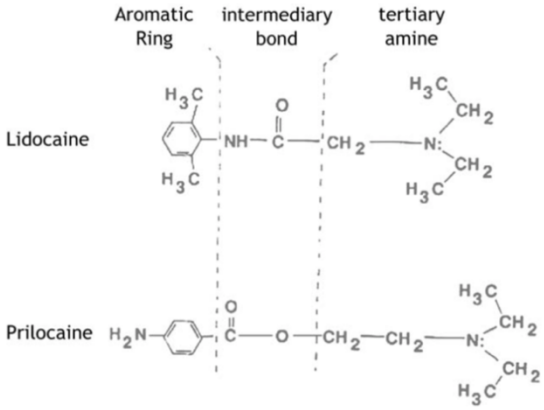


Table 17.2 Physicochemical properties and relative potencies of clinically used local anesthetics.

Local anesthetic	pKa[a]	% Ionized (at pH 7.4)	Lipid solubility[b]	% Protein binding	Relative anesthetic potency[c]	Relative potency for CNS toxicity[d]	CV:CNS ratio[e]
Ester linked							
Low potency, short duration							
Procaine	8.89	97	100	6	1	0.3	3.7
Chloroprocaine	9.06	95	810	7	1	0.3	3.7
High potency, long duration							
Tetracaine	8.38	93	5822	94	8	2	ND
Amide linked							
Intermediate potency and duration							
Lidocaine	7.77	76	366	64	2	1	7.1
Mepivacaine	7.72	61	130	77	2	1.4	7.1
Prilocaine	8.02	76	129	55	2	1.2	3.1
Intermediate potency, long duration							
Ropivacaine	8.16	83	775	94	6	2.9	2
High potency, long duration							
Bupivacaine	8.1	83	3420	95	8	4	2
Levobupivacaine	8.1	83	3420	>97	8	2.9	2
Etidocaine	7.87	66	7317	94	6	2	4.4

- pKa: determines the local anesthetic onset
    - LAs exist in a chemical equilibrium b/w the basic uncharged form (B) and charged cationic form (BH+)
    - pKa is the hydrogen concentration where concentration of LA base is equal to the concentration of charged ion
    - pH = pKa + log [B]/[BH+]
    - Most pKA ~ 7.7-8.5
        - The higher the pKa, the higher the ionic form % → lower the concentration of non-ionic form and slower speed of onset
        - If the environment is acidotic, it increases the ionized fraction of the drug → slower onset and poor quality of LA
- Half life
    - Esters: only a few minutes d/t rapid hydrolysis in plasma and liver
    - Amides: few hours
- Lipid solubility: the most significant factor in determining potency

    - Highly lipophilic → easily penetrate nerve cell membranes and become intracellular → more blockade
    - E.g. bupivacaine is more lipid soluble and more potent than lidocaine
- Protein binding: determines the duration of conduction block
    - Greater protein binding → greater affinity to receptor sites and remain with Na+ channel for longer → long duration

Pharmacokinetics

- Absorption depends on:
    - Vascularity: greater it is, more extensive and rapid absorption
        - Intercostal > epidural > brachial plexus > sciatic
    - Intrinsic vasoactivity: local vasodilation increases systemic absorption
    - Additive such as epinephrine will delay systemic absorption
- Distribution
    - Ester: once in bloodstream, it is rapidly hydrolyzed by plasma pseudocholinesterase = limits tissue distribution
    - Amide: widely distributed into different organs and binds to a1 acid glycoprotein in plasma
        - Undergoes 1st pass pulmonary uptake which decreases plasma concentration
- Metabolism
    - Ester: cleared by pseudocholinesterase → ester hydrolysis
        - Procaine & benzocaine hydrolyzed to para-aminobenzoic acid = allergic rx
    - Amide: metabolized in liver by CYP450
- Excretion
    - Ester LAs excreted in urine
    - Amide LAs excreted in urine or bile

<u>Common types of LAs</u>

	Use	Duration	Speed	Comment
Amino-esters				
Procaine	Infiltrative and nerve blocks	30-60 min	Quick	Epinephrine added to prolong effect
Proparacaine	Topical- corneal	15-30 min	1 minute	Nonirritant, doesn't affect pupils
Tetracaine	Topically or intrathecal	2-3 h	Fast (3-5 min)	Not widely used
Amino-amides				
Lidocaine	Infiltration anesthesia, peripheral nerve blocks, epidural, intrathecal, intravenous regional anesthesia	1 hr 2 hr w/ epinephrine	Fast (5-15 min)	Class 1b antiarrhythmic Analgesia Anti-inflammatory effects Can cause local irritation Toxic dose: 12mg/kg dogs, 6mg/kg cats
Mepivacaine	Peripheral nerve blocks	1.5-3 hr	Fast (5-15 min)	Ineffective as topical Lower neurotoxicity Toxic dose: 20-30mg/kg dogs

Bupivacaine	Infiltrative, peripheral nerve, epidural and intrathecal blocks	4-5 hr 8 hr w/ epinephrine	Slow (20-30min)	Highly lipophilic High cardiotoxicity potential Toxic dose: 5mg/kg dogs and cats

Nocita ®: bupivacaine liposome injectable suspension

- Long acting (up to 72hr) LA
- Contains multivesciular liposomes (MVL) which leads to increased stability and longer duration of drug release
    - Liposomes made of nonconcentric lipid bilayers
    - Bilayers broken down by enzymes so bupivacaine is gradually released over 72 hours
- Licensed for LAs for CCL sx in dogs and regional post-op analgesia for onychectomy in cats
- Administered by surgeon at the site using the moving needle technique

<u>Contraindications for LAs</u>

- Infiltration
    - Infection at injection site
    - Extensive fibrosis at injection site
    - Epinephrine containing LAs at areas w/o collateral circulation
    - Previously known hypersensitivity to LAs
- Epidural
    - Coagulopathy
    - Uncorrected hypovolemia or hypotension
    - Infection/neoplasia at injection site
    - Septicemia or bacteremia
    - Anatomical disruption to landmarks

<u>Adverse Effects</u>

1. Systemic toxicity

- Occurs at high plasma concentration d/t inadvertent direct intravascular injection of the LAs solution whilst performing peripheral or neuraxial blocks
- More lipid soluble drugs (e.g. bupivacaine) are more potent at causing systemic toxicity than less soluble ones (e.g. lidocaine)
- CNS toxicity
    - Follows progression as the plasma concentration increases
    - Low dose: act as anticonvulsants but have sedative effects
    - As plasma levels increase, LAs inhibit cortical neurons → increased excitatory function → muscle twitching then seizures
    - As plasma levels continue to increase, it can result in CNS depression, unconsciousness and coma
    - Seizure dose (dog): bupivacaine 5mg/kg (2mg/kg/min), lidocaine 22mg/kg (8mg/kg/min)
    - Seizure dose (cat): lidocaine 12mg/kg
    - Inverse relationship exist b/w seizure threshold dose and the arterial CO2 tension

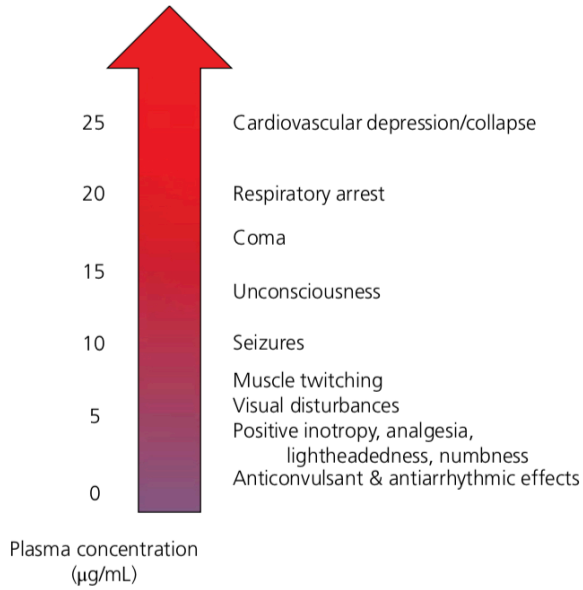


Figure 17.5 Progressive signs of lidocaine systemic toxicity with increasing plasma concentrations. Note: concentrations are approximate and depend on various factors (see text).

- Cardiovascular toxicity
    - Low dose = antiarrhythmic
    - High dose = can lead to cardiac toxicity
        1. They block cardiac Na+ channels to decrease the maximum rise of phase 0 of action potential → pronounced and evolving inhibition of cardiac contraction
        2. Myocardial depression: decrease HR, direct negative inotropic effects
        3. Ventricular arrhythmia possible
    - General anesthesia prolongs cardiovascular toxic effects
    - Hyperkalemia can increase LAs toxicity (half the toxic dose)

2. Local toxicity
    - Neurotoxicity: rare complication
        - Suspect d/t injury to Schwann cells (time & concentration dependent), inhibition of fast axonal transport, disruption of blood-nerve barrier, decreased neural blood flow w/ associated ischemia, and disruption of cell membrane integrity
    - Myotoxicity: concentration dependent; causes acute myonecrosis and degeneration

        - Suspect d/t dysregulation of intracellular Ca2+ concentration and/or alteration in mitochondrial bioenergies
    - Chondrotoxicity: greater risk of chondrolysis w/ longer exposure to a higher concentration of LAs
3. Methemoglobinemia
    - MetHb produced by oxidative damage to the Hb molecule; specifically, iron of heme group oxidized to ferric (Fe3+) form, which can't bind O2
    - Ester-type benzocaine causing MetHb via topical (intranasal or topically on larynx) reported in dogs and cats
    - Amide-type prilocaine reported in humans
4. Toxicosis (oral ingestion)
    - Lidocaine, benzocaine and tetracaine found in many prescription and non-prescription products
    - Benzocaine toxicity in cats: v+, depression, cyanosis, dyspnea, and tachypnea
5. Allergic reactions
    - Ester-type LAs associated w/ higher incidence of allergic rx d/t PABA metabolite
    - Amide-type do not undergo such metabolism = rarely cause allergic rx
    - Can progress into anaphylaxis

LA toxicity in cats

- Hemoglobin in cats more susceptible to action of oxidizing agents (including aromatic amines)
- At increased risk for developing methemoglobinemia and Heinz body anemia
    - Oxidized form of iron (Fe3+) in Hb increases O2 affinity for Hgb and reduces O2 release
    - Oxidative denaturation of Hb results in Heinz body formation -> erythrolysis (risk increased by high # of free sulfhydryl groups on feline globin)

Treatment of toxicity

Box 17.1 Guidelines for treatment of local anesthetic systemic toxicity.

CNS toxicity
1. Intubate trachea, administer O_2 and ventilate.
2. Treat seizures with a benzodiazepine.

Cardiac arrest
1. Start basic cardiopulmonary resuscitation.
2. Administer epinephrine at low doses (≤1 μg/kg IV).
3. AVOID lidocaine, vasopressin, calcium channel blockers, and β-blockers.
4. Administer a 20% lipid emulsion IV.
    - Initial bolus 1.5–4 mL/kg over 1 min.
    - Continue with CRI at 0.25 mL/kg/min for 30–60 min.
    - If non-responsive administer additional boluses of 1.5 mL/kg (up to maximum 7 mL/kg).
    - CRI may be continued at 0.5 mL/kg/h until clinical signs improve (24 h maximum).

- To prevent ongoing oxidative injury: N-AC, ascorbic acid
- Consider methylene blue (4 mg/kg IV once) for methemoglobinemia in dogs, controversial in cats

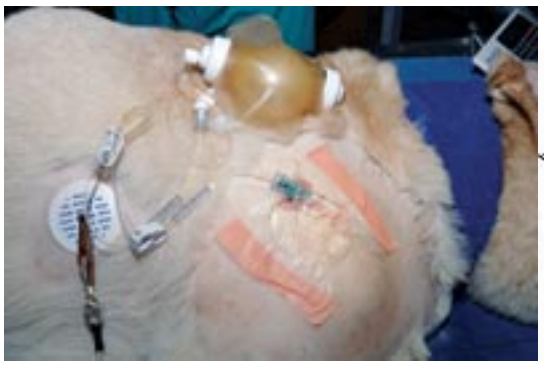
<u>Techniques</u>

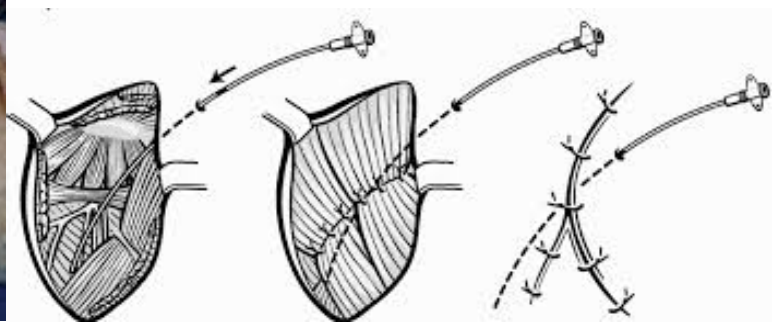
- Topical anesthesia: application of topical agents that are absorbed through the skin, mucosal, or corneal surface
- Infiltrative anesthesia: injection of LAs directly into a painful area or one to be operated on, subcutaneously or submucosally
- Peripheral nerve block: LAs injected near a specific nerve or nerve bundle
- Spinal anesthesia: injection of LA around the spinal cord → all segmental (sensory and motor) nerves passes through the anesthetic are paralyzed
    - True spinal anesthesia: injected into the dura mater and has subarachnoid access, and analgesic injected into CSF
    - Epidural anesthesia: injected into the extradural space; needle enters the spinal canal but does not penetrate meninges

LOCAL ANESTHETIC TECHNIQUES

Soaker catheter placement

- Diffuse or wound or diffusion catheter
- Fenestrated tubing placed with sterile technique at a painful site for continuous or intermittent administration of LAs
    - Purchased from MILA, or can DIY a red rubber
- Can be placed easily during a sx procedure e.g. limb amputation or large tumor resection
- CRI:
    - Priming dose of bupivacaine injected slowly
    - Then lidocaine CRI in dogs, or intermittent slow bupivacaine injection (dogs or cats)
    - Continued for at least 24 hours and up to 3 days
- Complications: seroma, edema, LAs toxicosis, infection or accidental premature removal





Long infiltration, incisional blocks and ring blocks

- Indications: wound repairs, toe wounds, toe and tail amputations on emergency basis
- Advantage:
    - Simple
    - Infiltrate at site of wound/incision → analgesia

- Reduce need for heavy sedation
- Complications: infection, pain on injection, decreased wound healing, drug rx, bleeding, ineffective block

Protocol 44.1 Local infiltration/line block

Procedure

1. Clip affected area.
2. Aseptically prepare area.
3. In one syringe, prepare mixture of 2% lidocaine 1–2 mg/kg and 5.0% or 7.5% bupivacaine 1–2 mg/kg (bupivacaine with epinephrine is suitable, as long as it is not a distal extremity). The volume needed depends on the size of the area being blocked. Alternatively, this block may be performed with single agent lidocaine or bupivicaine at the above doses.
4. With a syringe attached to a 25-gauge, ⅝-inch or a 22-gauge, 1-inch needle, insert needle subcutaneously, aspirate, inject mixture as you withdraw needle, and make a small bleb.
5. Repeat this procedure around the target area, in a rectangular or circular pattern. Make sure to split the dose of your drug equally throughout the area. It is always a good idea to anticipate how big of an area you will be blocking so that you do not exceed your total dose.
6. If your target area is a surgical incision, inject mixture along the incision, using either a 25-gauge, ⅝-inch or a 22-gauge, 1-inch needle (size depends on the size of the animal).
7. It is ideal to make these injections before the surgical process had begun; however, these blocks are still beneficial if done after the surgical procedure.
8. Alternatively, you can use a 22-gauge, 1.5- to 3.0-inch spinal needle (length depends on size of incision). Insert entirety of spinal needle under the skin, aspirate, and inject mixture as you remove the needle from the skin.

Protocol 44.2 Ring block

Procedure

1. Clip area distal to affected area, 360°.
2. Aseptically prepare site.
3. Prepare mixture of 2% lidocaine 1–2 mg/kg and 7.5% bupivacaine 1–2 mg/kg in a single syringe. Alternatively, this block may be performed with single agent lidocaine or bupivicaine at the above doses.
4. With the syringe attached to a 25-gauge, ⅝-inch needle, insert needle subcutaneously.
5. Aspirate; inject mixture as you remove the needle from the skin until a small bleb is formed.
6. Reinsert needle through first bleb, the area of skin that is already desensitized, and inject in the neighboring skin.
7. Repeat steps until you have injected around the circumference of the affected limb.

Intracavitary block

- Intrapleural:
  - Performed through chest tube that has been placed
  - Indications: post-op thoracotomy, rib fractures, thoracic trauma, cranial abdominal pain
  - Contraindication: flail chest (as LAs can leak into SQ space)
  - Complications: pain on injection, incomplete block, cardiac toxicity, infection (pyothorax)
    - If done w/o chest tube: lung laceration, pneumothorax

Protocol 44.4 Intrapleural block

Procedure

1. Aseptically prepare chest tube for injection.
2. Aspirate and remove any fluid or air from the pleural space through the chest tube.
3. Slowly inject a combination of 1 mg/kg of lidocaine mixed with 1 mg/kg of bupivacaine. Your total dosage should not exceed 2 mg/kg. If you prefer to use a single agent, inject 2 mg/kg of lidocaine or 1.5 mg/kg of bupivicaine.[32,33] If bilateral chest tubes are placed, simply divide the drug in half and administer one half of the drug into each chest tube. The bupivacaine alone may sting if it is not given with the lidocaine. Lidocaine alone will only last 30–60 minutes, whereas addition of bupivacaine will extend the analgesia to 4–6 hours.
4. Follow the injection with 5 mL of sterile saline or air to clear the chest tube of the local anesthetic and ensure dispersion into the thoracic cavity.
5. The block may be more effective if you lay the animal down in lateral recumbency for 10–15 minutes after the block, with the affected side down.

Protocol 44.8 Intraperitoneal block

Procedure

1. Position the animal in lateral recumbency.
2. Aseptically prepare site around the umbilicus.
3. Using a 90° angle, insert a 22-gauge, 1 or 1½-inch needle through the skin just ventral to the umbilicus until the needle is within the peritoneal cavity. Depending on the thickness of the subcutaneous tissue, a 1-inch needle usually penetrates into the peritoneal cavity. Usually there is a small loss of resistance as the needle breaks through the parietal peritoneum.
4. Aspirate once in the abdominal cavity. If fluid is aspirated, then do not inject. Commonly the spleen or bladder is hit accidentally with the needle and the procedure needs to be redirected. An ultrasound machine is helpful to determine if fluid is already present within the abdominal cavity prior to injection to know if fluid is expected on aspiration. If no fluid is aspirated or known fluid is present via ultrasound verification, inject 0.5–1.0 mL 7.5% bupivacaine diluted into 9 mL of 0.9% NaCl (amount of bupivacaine depends on the size of the animal). Your total dosage should not exceed 2 mg/kg.

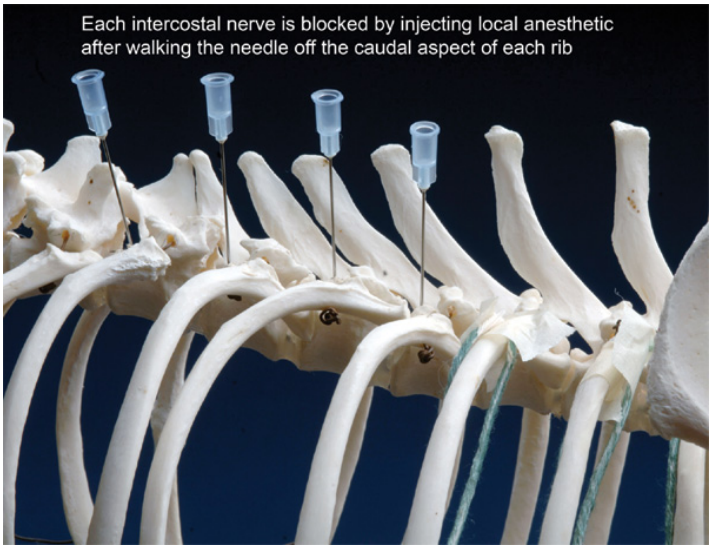
Intercostal nerve blocks

- Indication: lateral thoracotomy, rib fractures, thoracic trauma, cranial abdominal pain
- Contraindication: flail chest, infection
- Complications: bleeding, pneumothorax
- The intercostal nerves descend in the intercostal space along the caudal border of each rib, associated with the ventral branches of the intercostal artery and vein
- Block 2-3 intercostal nerves cranial to the incision (or fractured ribs) and 3 caudal to it, in addition to the site of interest
- Conscious patient will likely require some sedation for this procedure

Protocol 44.5 Intercostal nerve blocks

Procedure

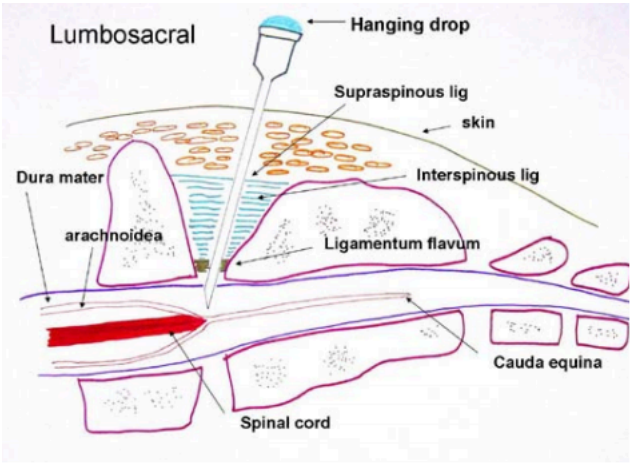
1. Two adjacent intercostal spaces (see Figs. 44.2 and 44.3) both cranial and caudal to the incision or area of discomfort must be blocked due to the nerve supply overlap.[33]
2. Using a 90° angle, insert a 25-gauge, ⅝-inch or a 22-gauge, 1-inch needle through the skin caudal to the rib near the intervertebral foramen.
3. Aspirate, and if no blood is withdrawn, then inject 0.5–1.0 mL 7.5% bupivacaine (volume depends on the size of the animal) at each site. Your total dosage should not exceed 2 mg/kg.

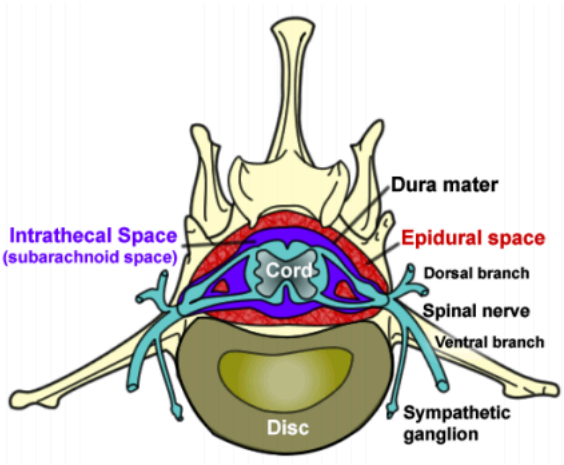


EPIDURALS

Epidural blocks

- Indications: thoracic/pelvic limb, abdominal or thoracic limb; coccygeal block can be performed for tail amputations and urethral deobstruction
- Effects of epidural anesthesia:
    - Goal is to paralysis sensory nerve to the area where sx will be performed
    - Muscle relaxation can be an added bonus or disadvantage
    - Muscle relaxation of limbs can cause recumbency, and of thoracic region limits respiratory movement
    - If LAs reaches C5+ where it affects phrenic nerve, respiration can cease
- Contraindications: local or systemic infection, severe pelvic fx disrupting anatomy, coagulopathy, thrombocytopenia, and hypotension
- Must be performed under general anesthesia or heavy sedation
- Complications: infection, hemorrhage, incomplete block, urine retention
- Location:
    - Lumbosacral junction between L7 and S1
        - Dog: spinal cord terminates around L6-7
        - Cats: spinal cord terminates at S3 = both SC and subarachnoid space are close





- Layers to go through: skin, subcutaneous fat, supraspinous ligament, interspinous ligament and ligamentum flavum (yellow ligament)
    - If it keeps going, it will encounter the dura mater, arachnoid membrane, pia meter, and spinal cord
        - 3 meningeal membrane = dura mater, arachnoid membrane, pia mater
        - CSF located in the subarachnoid space, separating the arachnoid membrane and pia mater
- For epidural: needle must enter the epidural space, which is between the ligamentum flavum and dura meter

    - Identify the space by advancing from an area of high resistance (ligamentum flavum) to an area of low resistance (epidural space)
- For spiral anesthesia: needle enters the subarachnoid space, b/w the arachnoid membrane and the pia meter (i.e. where myelograms are injected into)
- 2 techniques:
    - "Hanging drop"
        - Involves removing the style of spinal needle, filing the tube of the needle with saline or anesthetic solution, and allowing the drop to hang from the hub
        - As the needle is advanced through the ligamentous structure, it does not move
        - Once it enters the epidural space, negative pressure will draw the drop into the needle, indicating proper placement into the epidural space
    - "Lack of resistance"
        - Indicates proper placement of injection needle in the epidural space based on the amount of resistance to the injection of air or saline
        - Once in the epidural space, the injection of air/saline would have minimal resistance → saline syringe then replaced with syringe containing anesthetic and injection is completed
- Landmarks: palpate wing of ilium and spinous process of L7, then slide finger down the spinous process until the lumbosacral space is palpated (a slight divot)

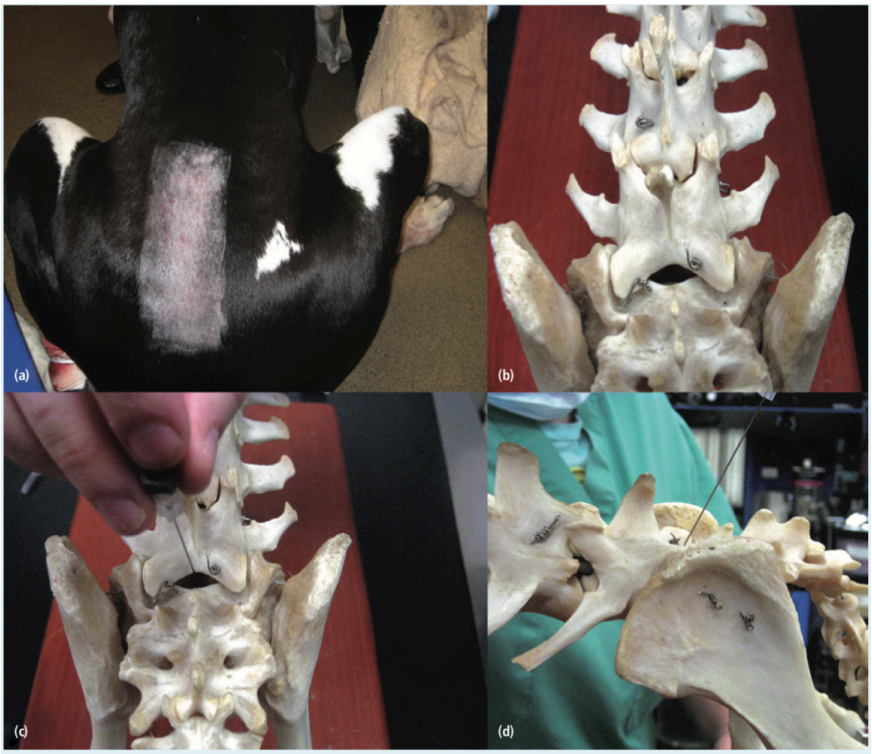


Figure 44.7 Epidural block. (a) Location of an epidural on a live dog. (b) Location of an epidural on a dog skeleton. (c) Location of needle placement on a dog skeleton: dorsal view. (d) Location of needle placement on a dog skeleton: lateral view.

Protocol 44.14 Epidural

Procedure

1. The patient should be placed in either sternal or lateral recumbency depending on the operator's preference. Some people extend the pelvic limbs cranially to possibly increase the size of the epidural space; this is a personal preference.
2. Clip an area at the lumbosacral junction (see Figs. 44.7A and B). Sterile technique is very important in this procedure, so clip an adequate area that allows aseptic technique.
3. Aseptically prepare the skin.
4. After washing hands and while donning sterile gloves, palpate the wings of the ilium with your thumb and middle finger. Using the index finger, palpate the spinous process of the seventh lumbar vertebra.
5. Slide the index finger caudally down the spinous process until the lumbosacral space is palpable. A slight divot can usually be palpated here between L7 and S1.
6. Keeping the index finger in place (to maintain positioning), insert a 20- or 22-gauge, 1.5- to 3.0-inch spinal needle (length and size of needle depend on patient size) perpendicular to the skin, ensuring the needle is precisely on midline in 360°.
7. Continue to advance the spinal needle slowly, adjusting the needle angle as needed either cranially or caudally, to ensure proper placement in the epidural space (see Figs. 44.7C and 44.7D).
8. The epidural space sits just ventral to the ligamentum flavum. As the needle is advanced through the ligamentum flavum, usually a "pop" can be felt, although this is not a completely reliable indicator.
9. To ensure correct epidural placement of the needle's tip, remove the stylet, and using a *glass* syringe, which provides little to no resistance, inject a small amount of air (0.25–1.0 mL depending on patient size). While injecting air, there should be no resistance and no back pressure on the plunger of the syringe. If resistance or back pressure on the plunger is appreciated, you are most likely not in the epidural space. Repeat the preceding steps to obtain proper placement.
10. Another method of verifying correct needle placement is by using the "hanging drop" technique. This technique is best performed with the patient in sternal recumbency. Once the needle is placed in the skin, remove the stylet and fill the hub of the needle with saline or local anesthetic. Once you are in the epidural space, the fluid in your needle will drop into the epidural space. This technique is not 100% accurate because tissue plugs can obstruct the needle.
11. Once correct needle placement is verified, examine the needle for blood or cerebrospinal fluid (CSF). If none is observed, gently aspirate the needle to reconfirm absence of blood and CSF.
12. Slowly inject the opioid of choice (refer to Table 44.1). It should inject freely with no resistance, similar to an IV injection. If resistance is experienced, you are most likely not in the epidural space and you will need to repeat the preceding process.
13. Follow the opioid with bupivacaine 7.5%, 0.1–0.4 mg/kg; this too should inject with no resistance. If resistance is noted, you are most likely not in the epidural space and will need to repeat the process.
14. Once you have administered the drugs, remove needle, and place the patient with affected side down, allowing the drugs to disperse to the desired location.[38]

Coccygeal epidural in cats

- Blocks the pudendal, pelvic and caudal nerves → analgesia to the penis, anus, colon and perineal region w/o loss of motor function in the pelvic
- Location: space b/w the sacrum and 1st coccygeal vertebrae

Steps:

1. Once sedated, the patient is placed in ventral recumbency and the sacrococcygeal region surgically prepped. The injection site can be found by palpating the space between the sacrum and first coccygeal vertebra, which can be palpated as it moves when the tail is moved.
2. After donning sterile gloves, the injection site is located just cranial to the first coccygeal vertebrae. Alternatively, the first or second coccygeal intervertebral space can be used. To facilitate this step, the tail can be manipulated by an assistant (or use your "dirty hand").

3. A 25 gauge, 1 inch needle is inserted at a 30 to 45° angle at the midline of the sacro-coccygeal space (which is identified with the index finger of the other hand). While advancing the needle, a characteristic "pop" can be felt. This occurs as the needle penetrates the ligamentum flavum.
4. After entering the epidural space, a syringe is attached and gentle negative pressure applied. If blood or cerebrospinal fluid is obtained, the procedure needs to be started again.
5. If no blood or any other fluid is aspirated, proceed to infuse the calculated volume (0.1-0.2mL/kg 2% lidocaine) into the epidural space. No resistance to injection should be noticed. Inappropriate infiltration into the subcutaneous tissue may create resistance.
6. Epidural is working if there is relaxation of the tail and rectum; also, pinching of the tail should not produce a response. If a pain response is elicited after 5 minutes of the first injection, a second injection can be attempted. Due to the increase risk of complications, no more than 2 attempts are recommended.

Risk of coccygeal block:

- As SC ends around S1 in cats, low risk of iatrogenic puncture of SC or penetration into subarachnoid space
- Infection or abscess at site
- Failure to provide analgesia
- Possibility of systemic lidocaine absorption

Contraindications

- Coagulopathy, septicemia, pyoderma at site, severe hypovolemia or hypotension, anatomic abnormalities (Manx cat)

Epidural catheter

- Indications: severe abdominal or pelvic pain that is poorly responsive to other analgesic modalities
- Aim to place epidural catheter into epidural space of L7-S1
- Length of catheter placed inside the patient should be pre-measured, including the distance b/w skin to epidural space
    - Cranial abdominal pain: level of L1-2, L2-3
    - Pelvic origin pain: L5-6
- Tuohy needle: a hollow hypodermic needle with slight curve at the end (prevents puncture of dura mater)
- Troubleshoot:
    - If it stops functioning, obtain radiographs to confirm correct placement
    - If it appears in place, attempt to gently flush with sterile saline. If it does not work, then attempt flushing as the catheter is slowly removed. Do not force it back in once it has been removed from the epidural space

Protocol 44.15 Epidural catheter placement

Procedure

1. Epidural catheter kits are available with most if not all the components needed for the placement of the epidural catheter (see Fig. 44.8).
2. The procedure is fairly similar to that of an epidural, but in place of a regular spinal needle, a Tuohy needle is used. The curved tip of the needle allows the catheter to be passed in the appropriate direction (cranially) after needle insertion.
3. Follow the procedure for performing an epidural injection. However, replace the regular spinal needle with a Tuohy spinal needle.
4. Once in the epidural space, remove the stylet and pass the epidural catheter through the Tuohy needle.
5. The tip of the epidural catheter should be placed in close proximity to the painful area. Therefore, premeasuring the catheter prior to placement is important.
6. Remove the Tuohy needle while leaving the catheter in place.
7. Although not an absolute guarantee of correct placement, a radiograph can be performed to verify placement of the epidural catheter. Intended catheter placement is not always achieved because of coiling of the catheter and lateral deviation. The presence of an epidural catheter decreases the likelihood of failure, but it does not guarantee 100% success. If proper placement was not obtained, repeat steps 1–5.
8. It is important to keep the insertion port of the catheter clean and sterile at all times. The insertion site should be covered with a sterile bandage, and aseptic technique should be used when delivering drugs through the insertion port. Reapplication of a sterile bandage should be applied whenever administration of drugs is performed. The insertion site should be inspected daily for inflammation and infection.

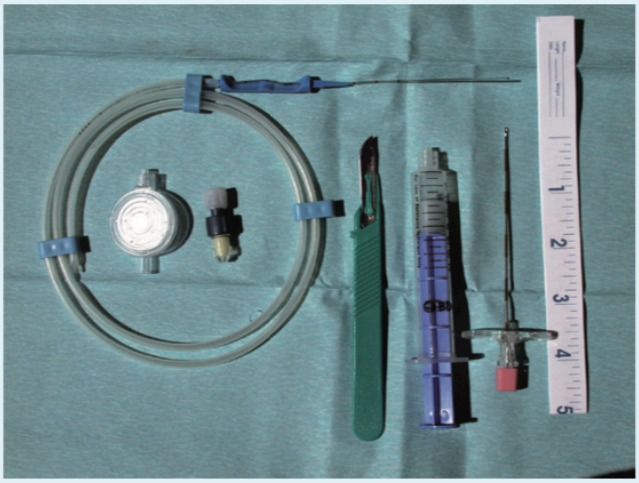


Figure 44.8 Picture of the components of an epidural catheter kit.

9. Do cut the catheter such that only 10-20cm of catheter remains outside of the patient.
10. Place occlusive plastic skin drape over the entire area to secure the catheter and to prevent accidental removal.
11. Plain radiographs should be obtained to confirm catheter tip in the desired location.