Local and Regional Anesthesia

Jessica Antonicic CVT, VTS (anesthesia/analgesia)
Nervous system

• Is an organ system that contains a network of specialized cells called neurons
  
  These neurons transmit signals between different parts of the body resulting in action

• There are 2 main parts to the system-central and peripheral
  
  ✓ Central - brain and spinal cord
  
  ✓ Peripheral - sensory neurons, ganglia, and nerves
    1. Somatic - innervate skin, joints and muscles
    2. Autonomic - innervate internal organs, blood vessels, and glands (sympathetic/parasympathetic)
Central Nervous System (CNS)
- Consists of the brain and spinal cord
- Responsible for sensory activities, storing memories and emotions.

Peripheral Nervous System (PNS)
- Consists of Cranial and spinal nerves
- Brings messages to and from the CNS to the rest of the body

Somatic Nervous System
- Responsible for voluntary movements (muscle movement)

Autonomic Nervous System
- Responsible for involuntary actions (heart beat, pupil dilation, etc.)

Sympathetic Nervous System
- Responsible for flight or fight response

Parasympathetic Nervous System
- Responsible for rest and relax actions (digestion, etc.)

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3 Peripheral Nerve types

- A-large, myelinated fibers
  - 4 types of A nerve cells
    - Alpha-carry motor, touch, and pressure information
    - Beta-carry motor, touch, and pressure information
    - Gamma-carry motor, touch, and pressure information
    - Delta-mediates pain and temperature sensations

- B-slightly smaller myelinated fibers-motor only

- C-small unmyelinated fibersmediate pain sensation
Vertebrates have 3 types of neurons

- **Sensory neurons** to CNS (afferent neurons)

- **Motor neurons** (efferent neurons) to effectors (muscles and glands)

- **Interneurons** (association neurons) provide associative functions
Neuron Function

- Nerve impulses are electrochemical currents that pass along the axon to the presynaptic membrane.
- The resting potential is -90 to -45.
- Depolarization is when the sodium ions flow inward and the potassium ions flow outward resulting in a decrease in electronegativity within the postjunctional membrane.
Action Potential

- Action potential is a rapid change in membrane potential when a nerve cell is stimulated, i.e. going from negative to positive in milliseconds.
- Reaches up to +30mv.
- Depolarization requires 0.2-0.4ms then repolarization returns the cell to resting potential.
- Muscle contraction is delayed 2-3ms.
Local Anesthesia

Defined as the use of a chemical agent on sensory neurons to produce a disruption of nerve impulse transmission, leading to temporary loss of sensation. Motor neurons may be affected leading to loss of voluntary motor control.
<table>
<thead>
<tr>
<th>Neuron Type</th>
<th>Function</th>
<th>Myelination</th>
<th>Order of Blockade</th>
<th>Signs of Blockade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A alpha</td>
<td>Motor—skeletal muscle</td>
<td>Myelinated</td>
<td>Fifth</td>
<td>Loss of motor function</td>
</tr>
<tr>
<td>A beta</td>
<td>Sensory—touch, pressure</td>
<td>Myelinated</td>
<td>Fourth</td>
<td>Loss of sensation to touch and pressure</td>
</tr>
<tr>
<td>A gamma</td>
<td>Motor—muscle spindles; propriocoeption</td>
<td>Myelinated</td>
<td>Third</td>
<td>Loss of proprioception</td>
</tr>
<tr>
<td>A delta</td>
<td>Fast pain, temperature</td>
<td>Myelinated</td>
<td>Second</td>
<td>Pain relief, loss of temperature sensation</td>
</tr>
<tr>
<td>B</td>
<td>Autonomic, preganglionic sympathetic</td>
<td>Myelinated</td>
<td>First</td>
<td>Increased skin temperature</td>
</tr>
<tr>
<td>C</td>
<td>Slow pain, postganglionic sympathetic, polymodal nociceptors</td>
<td>Unmyelinated</td>
<td>Second</td>
<td>Pain relief, loss of temperature sensation</td>
</tr>
</tbody>
</table>
How do locals work?

• Local anesthetics produce conduction blockade by inhibiting voltage-gated sodium channels located on nerve cell membranes

• Impulses are slowed so that the threshold potential is not reached and the action potential is not propagated

• Nerve size is critical factor in determining sensitivity to local blocks

• The smaller unmyelinated C fibers are blocked before the myelinated A fibers
How do locals work?

• Locals are absorbed over mucosal, pleural, interpleural, epidural and peritoneal surfaces with high bioavailability

• Systemic absorption is determined by dose, volume, protein binding ability, lipid solubility, injection site blood flow, and use of a vasoconstrictor (epinephrine)

• All locals cause vasodilation—which accelerates systemic absorption
Advantages

• Low cardiovascular toxicity, low cost, excellent pain control post-op, and minimal patient recovery time due to no sedative effect

• When used in conjunction with general anesthesia it enhances pain control during and after surgery

• Dose of general anesthetic and all other drugs used is significantly reduced

• Have minimal effect on cardio and respiratory system—good for high risk patients
Inhibit Perception
- Anesthetics
- Opioids
- $\alpha_2$ agonists
- Benzodiazepines
- Phenothiazines

Modulation of Spinal Pathway
(inhibit central sensitization)
- Local anesthetics
- Opioids
- $\alpha_2$ agonists
- Tricyclic antidepressants
- Cholinesterase inhibitors
- NMDA antagonists
- NSAIDs
- Anticonvulsants

Inhibit Transmission
(inhibit impulse conduction)
- Local anesthetics
- $\alpha_2$ agonists

Transduction
(inhibit peripheral sensitization of nociceptors)
- Local anesthetics
- Opioids
- NSAIDs
- Corticosteroids
Toxicity

- Tissue toxicity can occur from administering a local
  - Using a vasoconstrictor (epinephrine) can contribute to delayed wound healing and promote tissue necrosis

- Systemic toxicity can result from accidental IV administration
  - Usually manifests in CNS with symptoms of restlessness, muscle tremors, sedation, disorientation, and ataxia
  - Can progress to seizures, unconsciousness, respiratory arrest or cardiac complications

- Degrees of toxicity depend on dose, drug, and route administered
When to use locals

- A veterinarian determines when to use a local solo, or in conjunction with general anesthesia (GA)
  - Factors include: temperament, age, physical status of patient, cost, nature of operation, and anesthetist’s skill in performing procedure

- Some procedures that might require a local alone include: eye exam, urinary catheter placement, foreign body removal in eye, conjunctival scraping, small biopsy of skin, through chest tube, repair minor lacerations, etc

- Some procedures that might be tied with GA: declaws, orthopedic procedures, thoracotomies, dental extractions, arthroscopy, etc
# Local Anesthetics

<table>
<thead>
<tr>
<th>Local Anesthetic (Trade Name)</th>
<th>Maximum Dosage Without Epinephrine (mg/kg)</th>
<th>Toxic Dosage (mg/kg)</th>
<th>Onset of Motor and Sensory Blockade (minutes)</th>
<th>Duration of Motor and Sensory Blockade (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amide-linked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Articaine</td>
<td>4 (dogs); 3 (cats)</td>
<td>6</td>
<td>5–10</td>
<td>30–45</td>
</tr>
<tr>
<td>Bupivacaine 0.25%–0.5% (Marcaine)</td>
<td>3 (dogs); 2 (cats)</td>
<td>3.5–11</td>
<td>20–30</td>
<td>150–360</td>
</tr>
<tr>
<td>Etidocaine 0.5%–0.75% (Duranest)</td>
<td>3 (dogs); 2 (cats)</td>
<td>4.5–20</td>
<td>5–10</td>
<td>120–360</td>
</tr>
<tr>
<td>Lidocaine 0.5%–2% (Xylocaine)</td>
<td>8 (dogs); 6 (cats)</td>
<td>10 (dogs); 8 (cats)</td>
<td>10–15</td>
<td>60–120</td>
</tr>
<tr>
<td>Mepivacaine 1%–2% (Carbocaine)</td>
<td>5 (dogs); 4 (cats)</td>
<td>25</td>
<td>5–10</td>
<td>90–180</td>
</tr>
<tr>
<td>Ropivacaine 0.5% (LEA 103, Naropin)</td>
<td>3 (dogs); 2 (cats)</td>
<td>4.9</td>
<td>5–15</td>
<td>150–360</td>
</tr>
<tr>
<td><strong>Ester-linked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroprocaine 1%–1.5% (Nesacaine)</td>
<td></td>
<td>6</td>
<td>7–15</td>
<td>30–60</td>
</tr>
<tr>
<td>Procaine 1%–2% (Novocaine)</td>
<td></td>
<td>36–100</td>
<td>10–15</td>
<td>45–60</td>
</tr>
</tbody>
</table>
Local Anesthetics

- **Lidocaine** - most commonly used due to
  - fast onset 3-5 min
  - moderate potency
  - short duration 60-90 min
  - versatility

- **Bupivacaine** - is also common but for the opposite reasons
  - Slower onset: 15-20 min
  - Longer duration: 180-480 min
  - High potency
Local Adjuncts

- Pure mu opioids: can be used to increase the efficacy and extend the duration of local blocks
  - Mostly used in epidurals and intra-articular blocks
  - Can be used on its own or in conjunction with local anesthetics
  - Preservative free morphine is the typical drug of choice
  - Minimal adverse effects are seen with peripheral administration

- $\alpha_2$ agonists can also be used
  - Mostly used in epidurals
  - Causes vasoconstriction which decreases systemic absorption
  - Acts at the dorsal horn of the spinal cord
Types of Blocks

- Topical
- Infiltration/Continuous infiltration
- Dental
- Eye and Orbit
- Intercostal
- Intraperitoneal
- Ring/Line
- Intraarticular
- Brachial plexus/Paravertebral
- IV regional anesthesia/Bier
- Epidural/Continuous Epidural
Topical

- Local anesthetics used topically can be used to: relieve pain during cleaning/dressing of wounds, examine of a painful eye, desensitize the larynx, minimize chest tube discomfort, place urinary catheters, etc.

- Drugs used for this technique: EMLA cream, lidocaine, bupivacaine, lidocaine gel, proparacaine, tetracaine, etc.
  - EMLA cream is typically used to desensitize intact skin for superficial minor procedures
    - A thick layer is applied to skin and covered with a bandage 10 minutes. Duration is 1-2 hours

- Application modalities: injectables used topically, creams, ointments, gels, powders, aerosols, and patches.
Topical
Infiltration

- Direct injection of local anesthetics is the most reliable and safest of all the local anesthetic techniques

- Lidocaine is the drug of choice

- Used mainly to anesthetize an area for small laceration repairs, small skin mass removals or biopsies, and incisional line blocks

- Lidocaine volume can be diluted with 0.9% NaCl if a larger volume is needed
  - Sodium Bicarbonate can be added to help reduce the pain at a 1:9 ratio
Infiltration

- Use aseptic technique; everything should be sterile, and use a small needle like a 22 or 25 gauge

- Needle should be placed just under the skin, aspirate (no blood), then slowly inject while advancing the needle (line)
  - For a mass, the local can be placed in a circle around the mass by inject a bleb under the skin then inserting the needle in to the previous anesthetized area and creating a circle of anesthetized skin, aspirating between each injection

- Do not inject local into infected tissue, and is not likely to be as effective in inflamed tissue

- Duration of effectiveness depends on drug used
  - Adding epinephrine helps prolong the effect of the drug by vasoconstriction
Continuous Infiltration via Soaker Catheter

- Provides analgesia directly to the affected tissues through a fenestrated catheter placed prior to incisional closure.

- Can be placed on an infusion pump as a CRI, a manufacturer supplied reservoir, or intermittent injections can be administered.

- Provides excellent analgesia for leg amputations, large tumor resections, TECA’s, and thoracotomies.
Dental

- Contraindications for block
  - Coagulopathies
  - Infection at site of injection
  - Anatomic malformation—results in uncertainty of needle placement
  - Sensitivity to local anesthetic used

- Can be difficult to perform in brachycephalics and obese patients due to inability to palpate landmarks

- Possible complications: trauma to nerve, inadvertent IV or intra-arterial injection, retrobulbar hemorrhage

- Drugs of choice: Lidocaine and Bupivacaine
Infraorbital Block

- Block will affect first, second, and third premolars, incisors, K9’s, and tissue rostral to the upper 4th premolars of the side being anesthetized.

- The foramen is palpable inside the upper lip just rostral to the fourth premolar.

- Should be used in caution with cats and brachycephalics due to the foramen’s proximity to the eyeball.

- To perform block: retract upper lip dorsally and palpate the foramen, then insert needle through buccal mucosa close to the maxilla in a caudal direction into the foramen without hitting bone. If you hit bone withdraw the needle, redirect and advance the needle. ASPIRATE then inject.
Maxillary Block

- Block will affect all the structures affected by the infraorbital block as well as the maxillary fourth premolar, all molars, and the tissue caudal to the fourth premolar.

- To perform this technique: Open the patient’s mouth wide and retract the lips caudally, then advance the needle in the dorsal direction perpendicular to the palate just behind the second molar. The needle should only be advanced 2-5mm beyond the mucosa (depending on size of patient). ASPIRATE then inject.
Maxillary Block

Zygomatic Arch

Maxillary Nerve Block
Maxillary Foramen
Mental Block

- Block will affect first three premolars, canines, incisors and tissues of mandible rostral to the foramen

- In dogs, the middle foramen is the largest and the one most commonly used.
  - Can be palpated ventral to first root of second premolar

- In cats, middle mental foramen is difficult to palpate
  - It is located ventral and slightly caudal to the K9s about midway down the jaw
Mental Block

- To perform block in dogs: retract the bottom lip ventrally, palpate foramen, insert needle into the mucosa aiming caudally and advance 1-2mm into the foramen, ASPIRATE and inject.

- To perform in small dogs and cats: retract the lip ventrally, palpate foramen, insert needle into the mucosa at the border of foramen halfway down the mandible, advance needle slightly, cats (do not advance into canal), ASPIRATE and inject.

- Digital pressure can be used to facilitate movement of the local into the foramen.
Mandibular Block

- Block will affect all teeth in the mandible including all tissue; if infiltrates more caudal can anesthetize tongue

- The nerve is blocked before its entry into the mandibular canal

- Foramen is located on lingual surface of mandible, is 2/3 of the distance from the last molar to the angular process.
  - In dogs - it is ½ to 1” from ventral surface of mandible
  - In cats - it is ¼” from ventral surface of mandible
Mandibular Block

• Extra-oral procedure
  • Locate notch under the mandible just before the angular process
  • Use the lateral canthus of the eye as a plumb line
  • Slide thumb under jaw toward lingual surface of caudal mandible and palpate foramen
  • Insert needle next to finger, parallel to lingual aspect, stop when the needle tip is about 1/3 the distance from the ventral to the dorsal aspect of the mandible
  • With tip of finger, feel for tip of needle, ASPIRATE and inject just caudal to foramen opening

• Intra-oral procedure
  • Palpate angular process extra-orally and mandibular foramen intra-orally
  • Insert needle just caudal to last molar toward angular process
  • Advance needle along lingual surface so that it is adjacent to the foramen
  • ASPIRATE and inject slowly
Intra oral mandibular block

Extra oral mandibular block
Mandibular block cat
Intra-articular Block

- Defined as an injection into a joint
  - Joints like: shoulders, stifles, elbows, hips, hocks, etc

- Common in humans and horses
  Not so common in small animal general practice due to lack of knowledge

- If used properly is a great addition to multimodal analgesia
  - Providing pain relief right at the site of injury

- Can be used before, during, or after surgery or not during surgery at all

- A variety of drugs can be used for IA injections:
  - Hyaluronic acid
  - Corticosteroids
  - Stem cells
  - Platelet rich plasma
  - Local anesthetics
  - Opioids
Intercostal Block

- Used for analgesia for a thoracotomy, pleural drainage, and rib fracture
- Not recommended in animals with pulmonary disease
- Need to be observed for several hours after block - potential for delayed pneumothorax
- Location is caudal border of rib near intervertebral foramen
- Minimum of 2 adjacent intercostal spaces both cranial and caudal to incision/injury should be blocked
Ring Block/Digital Nerve Block

- Blocks the superficial branches of the radial, median, and the dorsal and palmar branches of the ulnar nerve

- Provides effective analgesia to the distal extremity for onychectomies, toe amputations, etc

- No epinephrine due to potential for ischemic injury in the extremity

- Bupivacaine is the drug of choice and can be combined with lidocaine for faster onset

- To perform the ring block: inject 0.2-0.4mg/kg of local subcutaneously in three sites
  - Lateral and proximal to the accessory carpal pad
  - Medial to the accessory carpal pad
  - Dorsal-medial aspect of the proximal carpus
Digital Nerve Block/Ring Block
**IV regional Anesthesia/Bier Block**

- Rapid, reliable method for producing short term anesthesia of the extremities with minimal systemic absorption of the local anesthetic
- Block good for distal limb mass removals, wound management, surgical biopsy or foreign body removal
- Provides 60-90 minutes of regional anesthesia distal to tourniquet
- Place IV catheter in the distal limb (cephalic, saphenous)
- Place a rubber tourniquet or blood pressure cuff (with sphygmanometer) around the limb proximal to the IV catheter and tighten to occlude blood flow
  - It is important that the tourniquet does not come off early due to potential risk of rapid plasma uptake of local
- An Esmarch bandage can be placed to help exsanguinate the limb
- Inject Lidocaine or Mepivacaine into the catheter
  - Never use Bupivacaine
- Anesthesia will take about 5-10 min to achieve and will last about 90 min distal to the tourniquet then remove tourniquet
- Sensation should return in 5-10 min after removing the tourniquet with residual analgesia lasting another 20-30 min
Brachial Plexus Block

- Provides analgesia distal to the elbow and possibly including the elbow by blocking

- Drugs that can be used to perform this block are: local anesthetics, opioids, $\alpha_2$ agonists or any combination

- Patient should be heavily sedated or anesthetized

- Spinal needles are typically used to perform this block because normal needles are too short

- How to perform: patient should be in lateral recumbency, then insert the needle into the axillary region medial to and at the level of the shoulder joint, direct it parallel to the vertebral column- the needle’s distal end should lie just caudal to the spine of the scapula. ASPIRATE. Then slowly inject 1/3 of the volume, then slowly inject the remaining volume as you are removing the needle
Brachial Plexus Block

Notes: vertebral branches of (a) sixth, (b) seventh, (c) eighth cervical, and (d) first thoracic spinal nerve, (e) tuberosity of humerus, (f) first rib
Paravertebral Brachial Plexus Block

- Provides analgesia to the entire forelimb
- Drugs that can be used are locals, opioids, and α₂ agonists
- Animal should be heavily sedated or anesthetized
- The cervical spinal nerves C6, C7 and C8 and thoracic spinal nerve T1 are blocked as close to the intervertebral foramen as possible
- This block is technically more difficult to perform vs the brachial plexus block
- Potential complications: blockade of the phrenic nerve, pneumothorax, and inadvertent injection into the thoracic dural sheath could result in systemic hypotension and respiratory depression
Paravertebral Brachial Plexus Block
Epidural Anesthesia

- One of the most frequently used regional anesthetic technique described for surgical procedures caudal to umbilicus
  - Is recommended for C-sections since does not depress puppies

- Epidural space is located between the inner and outer layers of the dura mater in the lumbosacral intervertebral space

- Animal should be sedated, tranquilized, or under GA to perform procedure

- Can be placed in sternal recumbency with legs folded cranially under animal or placed in lateral recumbency with legs pulled forward
  - This technique helps open up vertebral space

- Contraindications: increased intracranial pressure, clotting disorders, uncorrected hypovolemia, degenerative central or peripheral axonal diseases, anatomical abnormalities (broken pelvis), or skin infection
Epidural Anesthesia

• Clip hair over iliac wings of pelvis from L5-S3 and surgically prepare area thoroughly—sterile gloves should be used

• Spinal needle of the appropriate size should be used
  • 22g x 1.5” for <10kg patients
  • 22g x 2.5” for 10-45kg patients
  • 20g x 3.5” for >45kg patients

• Palpate iliac wings on either side of spine using thumb and middle finger of one hand, locate spinous process of L7 with index finger—can do this prior to scrub to get an idea of where the area is prior to performing block

• Move finger back and forth to find L7-S1 interspace—should feel like a divot

• Midline positioning is critical to avoid contact with the L7 vertebra

• Insert spinal needle, bevel pointing cranially and stylet in place, just caudal to L7 on midline until a popping sensation is felt—stop advancing the needle

• Loss of resistance test should properly identify space—air-filled or saline-filled syringe should be used or hanging drop technique—the stylet needs to be removed first

• Blood and/or CSF should not be present if they are remove needle and try again

• Should elevate head for ~5min to prevent excessive cranial advancement of anesthetic

• Bevel orientation makes a difference—so bevel should face the head so it split rather than cuts dural fibers
Epidural Anesthesia

Drugs

- Depends on size, desired extent of anesthesia, and desired onset and duration of effect.
- There are so many combinations-local, opioid, alpha 2, ketamine and combinations of them all.
- Most common is local alone, opioid alone or combination of local and opioid.
- Talk with DVM to get combo and dosages that they like to use.
- To properly prepare the syringe after a drug protocol is established, draw a small volume of air into the syringe then attach the syringe to the spinal needle-leaving a bubble on top of the fluid.
  - If the needle is in the right place the fluid should flow with no resistance.
- Observe the patient after injection to see if the epidural was successful: relaxation of the anal sphincter and tail should be observed, a lack of response to surgical stimulus, and a need for less gas anesthesia.
### Indications and Drug Dosages for Local and Regional Anesthesia Techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Indications</th>
<th>Drugs, Dosages, Equipment (use lower dose range in cats)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration anesthesia</td>
<td>Minor lacerations, mass excisions, surgical incision site anesthesia</td>
<td>• 2–5 mg/kg 2% lidocaine or 5–8 mg/kg 2% lidocaine plus epinephrine and/or 1–2 mg/kg 0.5% bupivacaine subcutaneously</td>
<td>• Avoid IV or intra-arterial injection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May increase volume by dilution up to 33% with sterile saline solution.</td>
<td>• Avoid epinephrine when blocking ears, tails, and distal extremities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sterile 22- to 25-ga, 1-in hypodermic needle and syringe.</td>
<td>• Avoid injecting near tumors or abscesses.</td>
</tr>
<tr>
<td>Splash blocks</td>
<td>Direct application to the body wall, peritoneum, or ovarian ligaments</td>
<td>• 4 mg/kg 2% lidocaine or 2 mg/kg 0.5% bupivacaine topically</td>
<td>Do not flush the area after application of local anesthetic.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sterile 22-ga, 1-in hypodermic needle and syringe.</td>
<td></td>
</tr>
<tr>
<td>Digital nerve blocks</td>
<td>• Digit surgery</td>
<td>• 0.2–0.4 mg/kg of 0.5% bupivacaine subcutaneously at each site or inject local anesthetic in a ring proximal to the carpus or digit</td>
<td>Avoid using epinephrine.</td>
</tr>
<tr>
<td></td>
<td>• Feline omeectomy</td>
<td>• Sterile 22- to 25-ga, 1-in hypodermic needle and syringe.</td>
<td></td>
</tr>
<tr>
<td>Intravenous regional block (Bier block)</td>
<td>Surgery of the distal limbs: digit amputation; mass removal or biopsy, wound repair</td>
<td>• 2.5–5 mg/kg (dogs), 2–3 mg/kg (cats) 2% lidocaine; or 1–2 mg/kg (dogs), 1 mg/kg (cats) 1% mepivacaine</td>
<td>• Bupivacaine should never be used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• +/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td>• Ischemic damage to tissue is possible if the tourniquet is left on &gt; 90 minutes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• +/- medetomidine 0.5 µg/ml of local anesthetic; alternatively, dexmedetomidine may be used at 0.25 µg/ml of local anesthetic*</td>
<td>• Rapid systemic uptake of local anesthetic is possible if the tourniquet fails, resulting in possible toxicosis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sterile 18- to 22-ga IV catheter and tourniquet or sphygmomanometer cuff.</td>
<td></td>
</tr>
<tr>
<td>Localized continuous or intermittent local anesthetic delivery (soaker-type catheter)</td>
<td>After limb amputation or large tumor resection, or to palliate painful but nonresectable lesions</td>
<td>• 1–2 mg/kg/hr lidocaine or mepivacaine for continuous administration</td>
<td>• Avoid toxic doses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1–2 mg/kg bupivacaine for intermittent administration (every four to six hours)</td>
<td>• Intravascular or intraneural anesthetic administration, infection, and hematoma formation are potential complications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Soaker-type catheter and elastomeric or electronic reservoir or syringe pump</td>
<td>• Keep in place one to three days; can be longer with strict aseptic technique.</td>
</tr>
</tbody>
</table>

* The medetomidine and dexmedetomidine dosages are based on the authors' clinical experience. The authors also note that the effective minimum dosages have not been determined, but doses less than 1 µg/kg (total) of medetomidine or dexmedetomidine should be safe in patients with cardiovascular stability.
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<tr>
<td>Intra-articular stifle block</td>
<td>Stifle surgery</td>
<td>2–5 mg/kg 2% lidocaine or 2 mg/kg 0.5% bupivacaine</td>
<td>Join joint infection is a potential complication. Follow an aseptic technique.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
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<td></td>
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<td>Sterile 22- to 25-ga, 1-in hypodermic needle and syringe</td>
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</tr>
<tr>
<td>Intercostal nerve blocks</td>
<td>Lateral thoracotomy, rib fractures, thoracic trauma</td>
<td>1–4 mg/kg (dogs); 1–2 mg/kg (cats) 0.5% bupivacaine</td>
<td>Avoid IV or intra-arterial injection. Block three intercostal nerves in front of the incision (or fractured rib) and three caudal to it, in addition to the site of interest.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterile 22- to 25-ga, 1-in needle and syringe</td>
<td></td>
</tr>
<tr>
<td>Intraperitoneal analgesia</td>
<td>Post-thoracotomy, rib fractures, thoracic trauma, cranial abdominal pain</td>
<td>Infiltrate 0.2–0.5 mL 0.2% lidocaine at the site of needle penetration</td>
<td>Lung laceration and pneumothorax are potential complications. If using a chest tube, follow with injection of 3 to 5 mL sterile saline solution to flush the tube.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1–2 mg/kg of 0.5% bupivacaine through a chest tube or butterfly or IV catheter, stopcock, and syringe</td>
<td></td>
</tr>
<tr>
<td>Intraoperative direct brachial plexus block</td>
<td>Forelimb amputation</td>
<td>1–2 mg/kg of 2% lidocaine and/or 0.5% bupivacaine dropped onto the exposed nerve or injected into the perineurium of each nerve 3 to 5 minutes before transection</td>
<td>Neuroma formation is a potential complication with injection into the nerve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterile 22- to 25-ga, 1-in hypodermic needle and syringe</td>
<td></td>
</tr>
<tr>
<td>Paravertebral brachial plexus block</td>
<td>Forelimb amputation, analgesia of the entire forelimb</td>
<td>1–4 mg/kg (dogs); 1–2 mg/kg (cats) 0.5% bupivacaine</td>
<td>Avoid IV, intra-arterial, or intrathoracic injection. Pneumothorax, phrenic nerve blockade, and injection into the dural sheath are potential complications resulting in high sympathetic blockade, hypotension, and respiratory depression.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterile 22- to 25-ga, 1-in hypodermic needle and syringe</td>
<td></td>
</tr>
<tr>
<td>Traditional brachial plexus block</td>
<td>Radial, ulnar, carpal, metacarpal, and digital fracture repair; wound repair; biopsy</td>
<td>2–5 mg/kg 2% lidocaine and/or 2 mg/kg 0.5% bupivacaine (can increase volume by dilution up to 50% with sterile saline solution)</td>
<td>Avoid IV, intra-arterial, or intrathoracic injection. Pneumothorax and phrenic nerve blockade are potential complications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterile 7.5-cm, 20- or 22-ga spinal needle and syringe</td>
<td></td>
</tr>
<tr>
<td>Radial, median, musculocutaneous, and ulnar nerve blocks</td>
<td>Analgesia of the elbow and antecubital region</td>
<td>2–5 mg/kg 2% lidocaine and/or 2 mg/kg 0.5% bupivacaine</td>
<td>Avoid IV or intra-arterial injection. Avoid direct injection into the nerve to avoid nerve damage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterile 22- to 25-ga, 1-in needle and syringe</td>
<td></td>
</tr>
</tbody>
</table>

*Dosages represent total maximum dose that is then divided among all injection sites.
# Indications and Drug Dosages for Infraorbital, Maxillary, Mental, and Mandibular (Inferior Alveolar) Nerve Blocks in Dogs and Cats

<table>
<thead>
<tr>
<th>Indications</th>
<th>Drugs, Dosages, and Equipment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia of the upper or lower jaw; dental extractions, oronasal fistula or palate surgery, tumor biopsy or excision, maxillectomy, or mandibulectomy</td>
<td>• For dogs and cats: 2 mg/kg 2% lidocaine or 0.5 mg/kg 0.5% bupivacaine or 1 mg/kg lidocaine and 0.25 mg/kg bupivacaine in combination</td>
<td>• Potential complications include trauma to the nerve, resulting in neurapraxia, and retrobulbar hemorrhage with the infraorbital block.</td>
</tr>
<tr>
<td></td>
<td>• +/- morphine 0.1 mg/kg or buprenorphine 0.01 mg/kg</td>
<td>• Always aspirate before injection to avoid IV or intra-arterial injection.</td>
</tr>
<tr>
<td></td>
<td>• Sterile 25- to 29-ga, 5/8- to 1-in needle and syringe</td>
<td>• Lower doses used in these blocks make systemic toxicosis less likely.</td>
</tr>
</tbody>
</table>
# Drugs for Epidural Use in Dogs and Cats

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose*</th>
<th>Onset Time**</th>
<th>Duration**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lidocaine 2% (20 mg/ml)</strong></td>
<td>3–5 mg/kg or 1 ml/7.5 kg for analgesia of pelvis or hindlimbs or 1 ml/6 kg for abdominal analgesia</td>
<td>10–15 minutes</td>
<td>1–2 hours</td>
</tr>
<tr>
<td><strong>Lidocaine 2% with epi- nephrine (5 mg/ml)</strong></td>
<td>As above</td>
<td>10–15 minutes</td>
<td>2–4 hours</td>
</tr>
<tr>
<td><strong>Mepivacaine 3%</strong></td>
<td>3–4.5 mg/kg or 1 ml/7.5 kg for analgesia of pelvis or hindlimbs or 1 ml/6 kg for abdominal analgesia</td>
<td>10–15 minutes</td>
<td>1.5–2 hours</td>
</tr>
<tr>
<td><strong>Bupivacaine 0.5%</strong></td>
<td>1–2.5 mg/kg or 1 ml/7.5 kg for pelvis or hindlimb analgesia or 1 ml/6 kg for abdominal analgesia</td>
<td>20–30 minutes</td>
<td>4–6 hours</td>
</tr>
<tr>
<td><strong>Morphine†</strong></td>
<td>0.05–0.15 mg/kg</td>
<td>30–60 minutes</td>
<td>12–24 hours</td>
</tr>
<tr>
<td><strong>Meperidine</strong></td>
<td>0.5–1.5 mg/kg</td>
<td>5–10 minutes</td>
<td>1–4 hours</td>
</tr>
<tr>
<td><strong>Oxymorphone</strong></td>
<td>0.025–0.15 mg/kg</td>
<td>20–40 minutes</td>
<td>7–10 hours</td>
</tr>
<tr>
<td><strong>Fentanyl</strong></td>
<td>0.001–0.01 mg/kg</td>
<td>5–20 minutes</td>
<td>2–4 hours</td>
</tr>
<tr>
<td><strong>Buprenorphine</strong></td>
<td>0.005–0.015 mg/kg</td>
<td>60 minutes</td>
<td>16–24 hours</td>
</tr>
<tr>
<td><strong>Morphine† and 0.5% bupiva- caine</strong>*</td>
<td>0.1 mg/kg morphine and 1 ml/7.5 kg bupivacaine for pelvis or hindlimb analgesia or 1 ml/6 kg bupivacaine for abdominal analgesia</td>
<td>30–60 minutes (morphine)</td>
<td>12–24 hours (morphine); 4–6 hours (bupivacaine)</td>
</tr>
<tr>
<td><strong>Morphine† and 0.1% bupiva- caine</strong>*</td>
<td>0.1 mg/kg morphine and 1 ml/7.5 kg bupivacaine for pelvis or hindlimb analgesia or 1 ml/6 kg bupivacaine for abdominal analgesia</td>
<td>20–30 minutes (bupivacaine)</td>
<td>12–24 hours (morphine); 4–6 hours (bupivacaine)</td>
</tr>
</tbody>
</table>

*Total drug volume should not exceed 8 ml. For example, if combining 0.1 mg/kg morphine (1 mg/ml) with 1 ml/7.5 kg 0.5% bupivacaine (5 mg/ml) in a lean, 60-kg dog, the calculated volume of morphine would be 6 ml and the calculated volume of bupivacaine would be 8 ml. Instead, 4 ml morphine and 4 ml bupivacaine should be administered. Sources: References 2–4.

**Sources: References 2 and 3.

***Base doses on ideal lean body weight, and further reduce doses of local anesthetics for pediatric, geriatric, and pregnant animals by 25%.

† Use preservative-free morphine formulations.
Questions

Anything further?? My email is jttiger01@hotmail.com if you have more questions.