Local Anesthesia & Loco-Regional Techniques in Cats
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Introduction
Local anesthetics were once a mainstay of pain management in veterinary medicine, and may now be one of the most under-utilized modalities despite its advantages, safety, ease of use, lack of expense, and that it is a ubiquitous tool in human surgery. In 2015, the AAHA/AAFP Pain Management Guidelines directed that local anesthetics should be used, insofar as possible with every surgical procedure.

Background
Local anesthetics were once a mainstay of pain management in veterinary medicine, and may now be one of the most under-utilized modalities. There are many reasons to combine general and local anesthetic for surgical pain relief.¹ Local anesthetic drugs are extremely effective, inexpensive and easy to use. When local anesthetic drugs are administered, pain impulses originating in the periphery are blocked and prevented from reaching the central nervous system. This blockade has several positive consequences:

- The sensation of pain is alleviated or even eliminated for the duration of the block. Local anesthetic drugs work by blocking sodium channels in nerve membranes. Decreased permeability to sodium slows the rate of depolarization so that the threshold potential is not achieved and an action potential is not propagated, thus the pain impulse is not propagated. Local anesthetics bind more readily to ‘open’ channels, thus rapidly firing nerves are more susceptible to blockade.
- The likelihood that ‘wind-up’ or hypersensitization will occur in the dorsal horn of the spinal cord is greatly decreased because the portion of the pain pathway called ‘transmission’ is blocked; this results in a lower incidence of exaggerated, sustained (i.e. maladaptive, neuropathic) pain states.
- The analgesia allows the patient to be maintained under a lighter plane of anesthesia and this makes the anesthetic episode safer for the patient. In fact, local anesthetic drugs decrease the minimum alveolar concentration (MAC) of all anesthetic gases and propofol.
- Creates a sparing effect of other analgesic medications, especially opioids and their attendant adverse effects
- Local anesthetics are recognized to have many beneficial effects beyond blocking nerve conduction; broad anti-inflammatory effects (reduced production of eicosanoids, thromboxane, leukotriene, histamine, and inflammatory cytokines; and scavenging of oxygen free radicals) and even antimicrobial, antifungal and antiviral effects.²³
- A limitation of LA is their generally short-duration of activity. However, the duration of activity can reportedly be doubled with small amounts of an opioid, either morphine (0.075 mg/kg) or buprenorphine (0.003 mg/kg), or alternatively dexmedetomidine (0.002 mg/kg) which provided 24 hours of analgesia in 2/3 of dogs receiving peripheral nerve blockade.⁴ Alternatively, buprenorphine and possibly dexmedetomidine did not increase anti-nociception of femoral and pelvic nerve blockade in cats.⁷
- New in 2016: Nocita®, a liposome-encapsulate bupivacaine product that provides up to 3 days of post-operative analgesia at the application site (canine label for cruciate repair closure). The pharmacokinetics of this product has been established in cats,⁸ and efficacy for 72 H in an onychectomy model.⁹

Furthermore, local anesthetic blocks are extremely cost effective and can increase profits to the clinic.

Commonly used local anesthetic drugs in veterinary medicine include

Lidocaine
  - Onset of action: rapid (less than 5 minutes), duration of action: 60-120 minutes
  - ‘Toxic dose’ in cats reported as 6-10 mg/kg
  - The general recommendation for clinical use is ≤ 3-4 mg/kg in the cat.

Bupivacaine
  - Onset of action: approximately 5-10 minutes after injection (up to 20 minutes), duration of action: 4 to 6 hours
  - Cardiotoxic when administered IV
  - Data is mostly anecdotal in the cat but the general feeling is that 3 mg/kg is the toxic dose.
  - The general recommendation for clinical use in cats is 1 mg/kg in the cat.

Adverse events caused by local anesthetic drugs: extremely rare but can include any of the following:

- Local tissue effects – swelling, bleeding, inflammation, dysthesias (‘tingling’? unknown if this occurs in animals). A commonly held misconception is that local anesthetics impair wound healing – although they can powerfully inhibit the inflammatory component of cellular tissue influx, there is no evidence to support a clinical effect of impaired wound healing. Both bupivacaine and ropivacaine have been implicated in myotoxicity when
injected IM, although this has not been listed as a complication in most human studies where these drugs were infused for 24 – 36 hours postoperatively into a wound bed. Anaphylaxis – rare, more common with esters (but still rare)

- Central nervous system – muscle tremors, seizure, coma. At lower concentrations, depression of inhibitory neurons occurs and can cause cerebral excitation, which may lead to seizures. At higher concentrations, profound CNS depression with subsequent coma, respiratory arrest and death can occur. This AE is more likely following IV boluses of large doses of lidocaine.
- Cardiovascular system – the myocardial conduction system is sensitive to local anesthetics and IV boluses can result in cardiovascular collapse. ONLY LIDOCAINE CAN BE ADMINISTERED IV (and never with epinephrine).
- Methemoglobinemia – rare, but can occur in cats. especially with esters e.g. Cetacaine® when sprayed on vocal cords to facilitate intubation, (the same AE not observed with a drop of lidocaine on arytenoid cartilages).
- Motor and autonomic nerves are also blocked by local anesthetics, and so motor weakness and vasodilation may occur with certain techniques. Blockade of essential nerve function, like that of phrenic nerve, or high epidural blocks, should be avoided. Motor weakness or paralysis of limbs, from spinal or major nerve trunk blockade is transient and as long as the patient is protected from injury and undue stress, should not be of consequence.

LOCOREGIONAL APPLICATIONS: The locality of administration is often limited only by the clinician’s ability to learn various utilities and anatomic landmarks; few are outside the scope of any clinician to master. For many of the blocks listed below, a suggested volume of drug is listed based on the amount of drug that can physically be injected into the site. However, with all blocks, the total dose that the patient can receive should be calculated and the cumulative dose (add up the dose or volume injected for each block) should not exceed this total dose.

1. Transdermal/cutaneous
   a. Commercial transdermal products are extremely useful in facilitating catheter placement and for minor procedures involving the dermis and epidermis. A lidocaine/prilocaine ointment formulation (EMLA®, also comes as a generic) is placed on a shaved area and covered with a non-porous wrap (foil or cellophane). In humans it is recommended to have the product in place for 45 minutes to achieve full affect, but in the author’s experience 15-20 minutes appears sufficient in dogs and cats. Penetration depth of analgesia has been reported to be time dependent and from 2-6 mm.
   b. Commercial 5% lidocaine patches (Lidoderm®) provides post-operative wound paraincisional analgesia. However, Lidoderm® patches in fact are manufactured and labeled for post-herpetic neuralgia (Shingles), a very common form of chronic, neuropathic pain in humans. The pharmacokinetics of this product has been investigated in dogs and cats, with minimal systemic absorption noted. The adhesive patches can be cut formed to the desired size and shape, for example on either side of an incision. Safety in cats wearing a whole patch for 5 days has been demonstrated. One cautionary note is that an entire patch contains 700 mg of lidocaine, obviously a dose that would be toxic if ingested; therefore adequate precautions need to be taken to ensure the patient is unable to access the patch.
   c. Studies in humans with moderate-severe stifle osteoarthritis reveal significant reduction in pain intensity after 2-week use of Lidoderm® patches, and pain relief similar to that achieved by oral NSAID. Their potential for use in animals for chronic pain conditions (e.g. osteoarthritis, osteomyelitis, osteosarcoma) remains plausible but no applications are described in the veterinary literature.

2. ‘Field’ block
   a. Blocking the ‘field’ of surgery. Local anesthetic drugs can be administered around the incision or directly into the incision. It is not true that lidocaine in an incision causes a delay in healing.
   b. Several veterinary studies demonstrate clinical efficacy of incisional local anesthetic. Two studies were unable to discern a difference using incisional LA; however these results may have been confounded by low dose, technique errors and use of other analgesic medications. Fitzpatrick et al (2010) In humans the overall preponderance of data including several systematic reviews supports the ability of incisional blocks to improve a number of outcome measures including patient comfort, reduction in use of opioids, earlier discharge, and diminished chronic pain states.

3. Intra-cavitary
   a. Intraperitoneal bupivacaine has demonstrated safety and a positive effect in cats at 2.0 mg/kg and dogs up to 4.4 mg/kg undergoing ovariohysterectomy. This is supported by multiple studies of similar techniques in humans having laparotomy. In humans intra-peritoneal (and even intra-pleural) infusions of bupivacaine are used to alleviate pain from pancreatitis.
   b. The bupivacaine is diluted in saline and left in as a final abdominal lavage. In a closed cavity (chest or abdomen), the bupivacaine can be injected through a catheter.

4. Indwelling diffusion/wound catheter block (sort of a long term field block)
Implantation of a catheter into the surgical wound site prior to closure allows repeated or continuous infusion of local anesthetics into the affected area over several days. Indwelling, or ‘diffusion’, catheters should be considered for large wounds or incisions e.g. amputation, mastectomies, wide-excision lumpectomies, etc.

i. Exit sites are separate from incision or penrose drains and secured with finger-trap suture.

ii. Local anesthetic drugs can be infused via a pump or administered by intermittent injection (e.g., q 6-8 hour injections of bupivacaine 1-2 mg/kg +/- mixed with opioid to extend duration).

iii. The catheter is generally removed in 48-96 hours.

b. In humans, relatively costly FDA approved catheters\(^a\) are used. For veterinary use, two moderately priced types are commercially available\(^b,c\). A recent review of wound incision catheters for surgery in humans, concluded that the overall: "Continuous wound catheters consistently demonstrated analgesic efficacy in terms of reduced pain scores or opioid use for all surgical subgroups, despite heterogeneity in type of surgical procedure, location of wound catheter, mode of delivery of local anesthetic, dose of local anesthetic, and analgesic mixture.\(^{27}\) Veterinary clinical studies report positive outcomes (including cats) with few complications.\(^{28,29}\)

Oral blocks (Figure 1): Blocks listed below will cause unilateral desensitization from the site of injection rostrally to midline.

5. **Maxillary or infraorbital nerve block**
   a. cranial approach
      i. The infraorbital nerve exits the infraorbital foramen, which can be palpated as a depression in the buccal mucosa dorsal to the distal root of the maxillary 3\(^{\text{rd}}\) premolar (just cranial to the root of the 4\(^{\text{th}}\) premolar or carnassial tooth in the area where the gingiva on the maxillary bone and the gingiva on the lip join together).
      ii. Block the nerve by injecting local anesthetic under the gingiva just rostral to the foramen and hold a finger at the site to promote caudal diffusion, there will be caudal migration of the local anesthetic into the canal sufficient to block the branches innervating the molars cranially.
      iii. A vessel runs with this nerve so aspirate, then slowly infuse drug (0.1 ml). Intra- and post-operative efficacy of this block has been established in the cat.\(^30\)

6. **Mandibular nerve block**
   i. The mandibular foramen or the mandibular nerve can often be palpated on the lingual side of the mandible just rostral to the angle of the mandible and just caudal to the last molar in approximately the middle 1/3\(^{\text{rd}}\) of the mandible (as measured from top to bottom).
   ii. Regardless of whether or not the nerve or foramen can be palpated (often difficult to palpate in very small patients), the landmarks described above will be utilized for deposition of local anesthetic drug.
   iii. The nerve ENTERS the mandible at the mandibular foramen and cannot be blocked between the mandibular foramen and the mental foramen. **Extraoral technique:** approach is from the outside, through the skin at the angle of the mandible. This technique is easier than the intraoral technique in cats and in some small dogs.
      1. Pass the needle through the skin along the medial aspect of the mandible with the needle perpendicular to the mandibular cortical bone, to the level of the foramen (again, aiming for a site just caudal to the last molar on the lingual side of the mandible).
      2. With a finger in the oral cavity the needle can be felt under the gingiva.
      3. When the site near the mandibular foramen is reached, aspirate and inject the local anesthetic drug (0.2 mls).

7. **Testicular block**
   a. Isolate body of testicles; insert needle to cranial pole and give extended aspiration to make sure not in vessel. Inject lidocaine or bupivacaine into the body of the testicle until you feel ‘pressure’.
      i. Drug will migrate up spermatic cord; takes approx. 10-15 min for max. effect.
   b. Generally <0.5 per testicle in cats will cause it to become turgid.
   c. For incision directly over testicle, continue infiltrating as the needle exits the testicular body to block the skin and subcutaneous tissue.

8. **Digit or paw block (Figure 2)**
   a. Three point (or four point)\(^31\)
      i. Locate the carpus and the accessory carpal pad and inject 0.1-0.3 mls subcutaneously at three sites:
1. medial to the accessory carpal pad (blocks median nerve and palmar branch of the ulnar nerve);
2. lateral and proximal to the accessory carpal pad (blocks dorsal branch of the ulnar nerve); and
3. on the dorsal-medial portion of the carpus (blocks superficial branches of the radial nerve).
4. The feline forelimb innervation anatomy has been more thoroughly described for the most precise placement.32

b. IV Regional Anesthesia (IVRA, “Bier block”)33
   i. Blood exsanguinated from cephalic vein by distal → proximal occlusion
   ii. Tourniquet is placed on cephalic vein firm enough to occlude venous but not arterial flow
   iii. Lidocaine 2 mg/kg (no epi!) is injected IV (some use catheter, some not); has been demonstrated safe in cats as well.34
   iv. Will take approx. 10-15 min for full effect, will block distal limb; max time for tourniquet 90 min.; do not remove tourniquet any earlier than 20 min. post injection to avoid IV bolus.

c. The innervation of35, and utility of, peripheral nerve blocks of the pelvic limb in cats have also been established36 (anti-nociception between 1-8 hours, most between 2-4H; motor function impaired for 1-2H37).

9. Intercostal block38
   a. Indicated for rib fractures, chest tubes, thoracotomy
   b. Inject local anesthetic in the tissues caudal to the proximal portion of the ribs. Inject local anesthetic in 2-3 rib spaces in front of and 2-3 rib spaces behind the area that needs to be desensitized.

10. Sacro-coccygeal block39
    a. Indicated for perineal, tail procedures including: relief of urinary obstruction, perineal urethrostomy, anal saccullectomy, peri-anal mass removal, tail amputation. Utility in combination with intratesticular lidocaine has been demonstrated in cats.40
    b. Patient is placed in sternal recumbency, palpate the space between the sacrum and the 1st coccygeal vertebra while dorsoflexing tail (between Cx 1-2 also acceptable)
    c. Clip & prep, Use a 25ga 1” needle to penetrate the skin at midline
    d. Direct the needle at a 30 to 45 degree angle and continue through the interarcuate ligament
    e. There may be a palpable “pop” when the ligament is penetrated; as the needle is advanced, there is no resistance upon entering the epidural space
    f. If bone is encountered, keep the needle in the skin and slightly angle the needle cranially or caudally off the bone until the space is entered
    g. The needle feels more firmly seated once the ligament is penetrated than it does in the subcutaneous tissues
h. Inject 0.5 ml of 2% lidocaine or 0.5% bupivacaine; there should be no resistance

11. Intra-articular block
   a. This block is used for analgesia following intraarticular anesthesia. Inject 1-5 ml local anesthetic into the joint prior to surgery and repeat the injection after the joint has been sutured closed.
   b. In vitro studies have demonstrated chondrotoxicity of 0.5% bupivacaine and 2% lidocaine; the clinical significance of single application is uncertain.
   c. If local anesthetics are concerning, use opioids! There are opioid receptors in the synovium and they are upregulated in inflammation.

12. Retrobulbar block
   a.

References:


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