Local Anesthesia in Veterinary Dentistry

There are two excellent articles (way better than this one) that you may also want to access. In fact, I highly recommend that you order the appropriate back-issues to get these articles (www.jvdonline.org).

Lantz GC. Step-by-Step – Regional Anesthesia for Dentistry and Oral Surgery. J Vet Dent 20(3), pp 181 – 186, 2003.

Beckman BW. Foundations – Pathophysiology and Management of Surgical and Chronic Oral Pain in Dogs and Cats. J Vet Dent 23(1), pp50 – 60, 2006.

Two other excellent resources would be the Veterinary Anesthesia Support Group (www.vasg.org) and the Anesthesia & Analgesia discussion board on the Veterinary Information Network (www.vin.com).

It has long been established that pain is far easier to control preemptively rather than reactively. That is, if you block a nerve prior to traumatizing the tissue 'down-stream', there is far less post-operative pain than if you do the surgery and then deal with the pain later. Also the plane of anesthesia required to keep a patient still depends on the level of stimulation the patient perceives. A light plane may be sufficient for minor scaling and polishing, but would not do for a surgical extraction.

In many dental practices, it is routine to use local anesthesia for invasive dental procedures to reduce the plane of general anesthesia required intra-operatively and the amount of pain post-operatively.

I have been using bupivicaine 0.5% with epinephrine (Marcaine E™) to block infra-orbital and mandibular nerves for any procedure likely to cause pain (extractions, root canal, periodontal flap surgery...), and I have been very pleased with the results. The blocks are easy to place, we can maintain patients at a much lighter plane of anesthesia and their recovery is very smooth and comfortable.

There are a number of questions yet to be answered about dental/oral nerve blocks such as:

- what is the onset and duration of action in cats and dogs for the various agents?
- in cats and small dogs, is a high volume/diluted bolus better than a low volume/high concentration bolus?
- when doing bilateral mandibular blocks in cats, is there the potential to cause laryngeal paralysis? (I have never seen evidence of this.)
- how much is enough?
- can you block the second maxillary molar with an infra-orbital block?

These questions, and others, will be answered in the coming months/years. For now, I want you to know that local anesthesia has found a home in veterinary dentistry. This is good news, especially for those clients who are nervous about general anesthetic. Every patient still needs a pre-anesthetic assessment and judicious use of anesthetic agents, but now we have one more tool to reduce the risk of anesthetic problems and to ease the degree of post-surgical pain.

Properties and Characteristics of Local Anesthetics Used in Veterinary Dentistry

Local anesthetic agents are weak organic bases and their penetration in tissue is impaired in acidic environments, as found in areas of infection or abscessation. Therefore, local nerve blocks are contraindicated in areas of infection and abscessation, as they will not work but may result in inoculation of infection into deeper tissues.

The more basic amide agents (lidocaine, mepivicaine, bupivicaine) have a faster onset of action and give more profound analgesia than the ester agents (procaine, propoxycaine, benzocaine). The amide agents also have longer duration of action due to protein binding and are less likely to result in allergic reaction than the ester agents (in humans at least). Amide agents are metabolized by the liver while ester agents are metabolized in the circulation.

All local anesthetic agents in use today cause vasodilation, which increases systemic absorption and decreases duration of effect. To counter this, a vasoconstrictor such as epinephrine is often added. This decreases rate of systemic absorption (reducing risk of systemic toxicity), increases duration of action and decreases local hemorrhage.

Vasoconstrictors may lead to serious side effects including tachycardia and arrhythmias (epinephrine and halothane are a bad combination for this). Bronchospasm may result due to allergic reaction to sulfites added to vasoconstrictor-containing solutions as antioxidants. Epinephrine can potentiate seizures if injected intra-vascularly.

Duration of effect has been well documented in humans, but is still a matter of conjecture and extrapolation in dogs and cats. The chart below shows the duration of pulpal and oral soft-tissue analgesia in humans in minutes for various agents.

Agent	Pulp	Soft tissue
Lidocaine with epinephrine	60-90	180-240
Mepivicaine with levonordefrin	45-75	120-240
Etidocaine with epinephrine	45-240	240-540
Bupivicaine with epinephrine	45-240	240-540

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Onset of action for bupivicaine has been reported to be anywhere from 3 to 30 minutes. In my experience, I feel I see onset of action by ten minutes in most cases.

Duration of analgesia in dogs and cats with bupivicaine and epinephrine may be as much as 6 to 8 hours as in humans, but more research is needed.

Landmarks for Local Dental Nerve Blocks

In human, canine and feline patients, there are six basic dental nerve blocks, all of which block sensory branches of the trigeminal nerve.

The majority of blocks are placed around nerves as they enter or exit various bony foramina. Typically, a vein and artery lie alongside the nerve. As the bony canals and foramina are small and the vessels are very close to the nerve, there is potential for intravascular injection. Dental syringes (see page 6) typically have a thumb-ring on the end of the plunger to allow for one-handed aspiration during placement of the needle. The syringe should be aspirated in two planes prior to starting the injection and a few times during the injection to ensure that the needle is extra-vascular.

Figure #1. View of a needle just entering the infraorbital foramen of a dog. This is the most spacious of the canals into which needles may be advanced.

If the needle is advanced through a narrow foramen (major palatine, for example), there is a risk of causing physical trauma to the nerve with the needle. Therefore, it is recommended to place the tip of the needle just at or barely into the foramen. Once the agent has been deposited, digital pressure for one minute can force the agent to flow deeper into the canal, providing anesthesia distal to the foramen.

Infraorbital Nerve Block

The infraorbital canal starts at the rostral floor of the orbit and runs rostrally, dorsal to the fourth premolar and opens on to the surface of the maxilla rostral to the zygomatic arch and dorsal (apical) to the maxillary third premolar tooth at the infraorbital foramen. The canal contains the infraorbital nerve as well as the infraorbital artery and vein.

Placement of the infraorbital block is done intra-orally. The infraorbital foramen is palpated as a depression dorsal to the distal root of the third

Figure #2. The infraorbital canal in most dogs is longer than in cats, allowing the needle to be advanced further before it reaches the suborbital space.

Figure #3 View of a needle just entering the infraorbital foramen of a cat.

Figure #4. The infraorbital canal in a cat is very short and so advancing the needle only a short distance with place the tip below the globe.

premolar and the needle inserted to the opening of the canal or just into the canal. Anesthesia will affect the ipsilateral premolar, canine and incisor teeth as well as the bone and soft tissue buccal to the teeth.

If direct pressure is placed over the foramen for one minute after placement of the dose, the agent will flow distally and block the caudal maxillary alveolar nerve to anesthetize the maxillary molars and the associated buccal bone and soft tissue.

Major Palatine Block

The landmark for this block in dogs and cats is the major palatine foramen. It is located on an imaginary line that runs half way between the dental arcade and the palatal mid line, at the level of the middle of the maxillary fourth premolar tooth. This small foramen cannot be palpated through thick palatal mucosa.

As this foramen is quite small, even a 30-gauge needle may be too large to safely fit within the lumen. Therefore, the needle should be advanced only until there is a loss of resistance at the opening of the foramen and not advanced further.

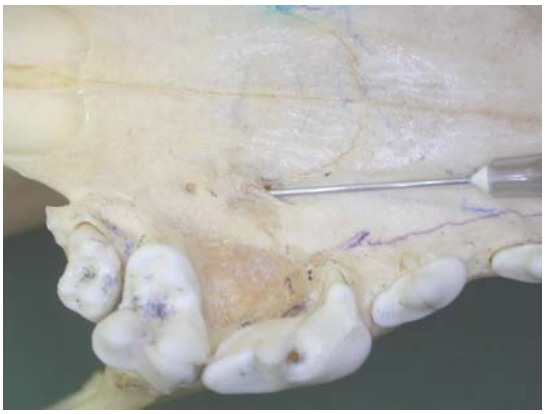

Figure #5. Needle placed in the major palatine foramen in a dog.

Figure #6. A needle placed at the major palatine foramen in a cat.

The major palatine block provides local anesthesia to the oral side of the hard palate. It would be indicated when dealing with palatal defects such as developmental or acquired clefts and maxillectomies.

Mental Nerve Block

The middle mental foramen is the largest of the three mental foramina and can often be palpated in medium to large dogs. In dogs, it is located apical to the first or second mandibular premolar at the junction of the ventral and middle thirds to the mandibular body. In cats, the middle mental foramen is located midway between the mandibular canine tooth and the third premolar tooth (cats have no first or second mandibular premolar teeth) at the dorsoventral midpoint of the mandible.

From an intraoral approach, the needle enters the mucosa rostral to the mandibular frenulum and is advanced distoventrally into the opening of the foramen. This block will anesthetize the buccal

Figure # 7. Anesthetic needle placed at the middle mental foramen of a dog.

mucosa and lip rostral to the foramen to the midline. If the needle is advanced deeper through the foramen into the mandibular canal, the canine and incisor teeth will also be anesthetized. However, due to the potential to cause trauma to the nerve and vessels, it is preferable to place the needle tip just inside the foramen and then apply digital pressure to force the agent deeper into the canal.

Figure #8. Anesthetic needle placed at the middle mental foramen of a cat.

Inferior Alveolar Nerve Block

The inferior alveolar nerve is located within the mandibular canal, ventral or adjacent to the mandibular tooth roots. Therefore, to block this nerve, it must be accessed before it enters the body of the mandible. The site at which the nerve is accessible is just before it enters the inferior alveolar foramen on the medial side of the ramus of the mandible. This block may be achieved with either an intraoral or an extraoral approach.

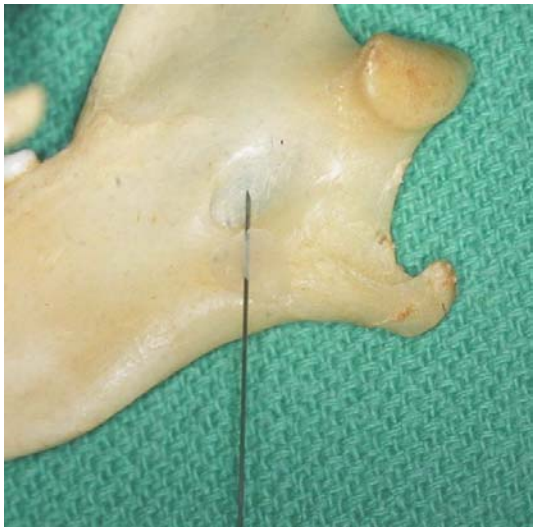

Figure #9. Anesthetic needle tip at the inferior alveolar foramen of a dog, on the medial side of the mandible directly dorsal to the middle of the concavity in the ventral border.

Figure #10. Anesthetic needle tip placed adjacent to the inferior alveolar foramen on the medial side of the mandible of a cat. There is no concavity in the ventral border of the mandible, as seen in the dog. This foramen can be found ventral to the midpoint of the zygomatic arch.

The landmark for locating the inferior alveolar foramen is most obvious in dogs. Along the ventral border of the mandible, just cranial to the angular process, there is a concavity. The foramen is dorsal to the middle of this concavity, on the medial side, half way between the ventral and dorsal borders of the mandible.

The extraoral injection starts by soaking the skin over the ventral concavity with alcohol. The needle is passed through the skin to the ventral border of the mandible and then walked off the medial side and advanced about half the width of the mandible. At this stage, the tip of the needle should be adjacent to the opening of the foramen and the anesthetic agent can be deposited.

Cats lack the concavity in the ventral mandibular border. The foramen lies ventral to the midpoint of the zygomatic arch.

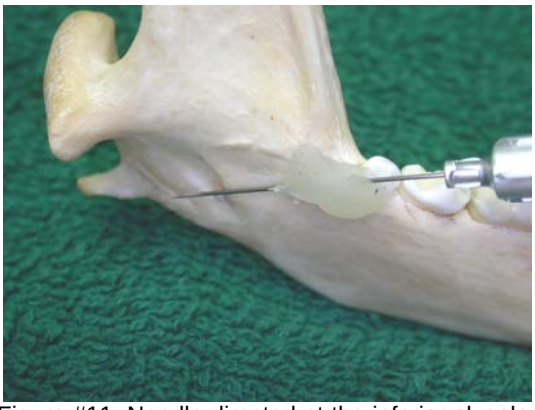

Figure #11. Needle directed at the inferior alveolar foramen in a dog. The needle is walked off the dorsal ridge of the mandible on the lingual side caudal to the last molar, aimed at and advanced half the distance to the angular process.

Figure #12. The same block in a cat.

I prefer the intraoral approach to the inferior alveolar foramen. The needle is inserted through the oral mucosa just behind the last molar and then walked off the medial side of the mandible. With the tip of the needle pointing in the direction of the angular process it is advanced to a point halfway between the last molar and the angular process. This will give anesthesia to all ipsilateral mandibular teeth and bone as well as all of the soft tissue lingual to the mandible. Care is taken to keep the needle close to the mandible and foramen to avoid also blocking the lingual nerve. If the lingual nerve is also blocked the patient may bite and traumatize its tongue on recovery.

Infiltration Nerve Block

Injection of anesthetic agent in the periapical region of a tooth will provide anesthesia for that tooth, providing the overlying bone is thin enough to allow diffusion of the agent. This would include maxillary teeth and the incisors. Infiltration can also be used to block areas of soft tissue such as the palate adjacent to maxillary teeth prior to extraction.

Instrumentation for Local Dental Nerve Blocks

The safest, easiest and most efficient way to administer local anesthetic for dental nerve blocks is to use the simple equipment designed specifically for the task. Local anesthetic agents are available in preloaded carpules containing 1.8 ml of the solution. The carpule is held in a reusable, autoclavable dental syringe fitted with a single-use needle.

The needles are available in 27 and 30 gauge in a variety of lengths.

The syringe has a thumb ring at the end of the plunger allowing one-handed aspiration and injection to ensure that the needle is not intravascular.

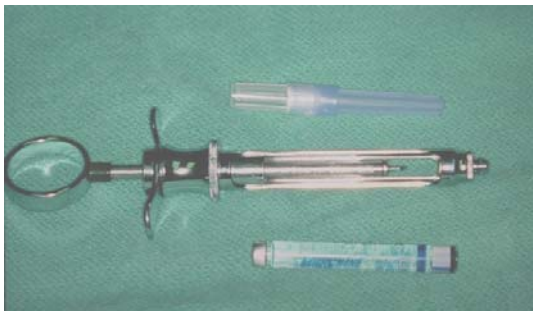

Figure #13. The photo shows a 30-gauge needle (top) with a dental syringe (middle) and a preloaded carpule of anesthetic agent (bottom).

The preloaded carpules do result in some wastage, but there is little to no risk of cross contamination and they are very convenient to use.

Dosages for Bupivicaine and Lidocaine with Epinephrine

Currently (July 2007), Marcaine (bupivicaine) E in carpules has been on backorder for about a year and may remain so for several more months. Marcaine neat (no epinephrine) may still be available in 50cc bottles but this means using regular syringes and needles. While this is still acceptable, I look forward to having the carpules available again soon (I miss them).

Dosages of bupivicaine with epinephrine in dogs and cats are based on some extrapolation as well as toxicity studies in dogs. In bulk bottles or in carpules, bupivicaine is 0.5% or 5 mg/ml. Therefore, a 1.8 ml carpule contains a total of 9mg. The maximum total dose of 0.5% bupivicaine with epinephrine in dogs is 2.0 mg/kg (0.4 ml/kg). For local dental nerve blocks, the recommended dose in dogs is 0.1 ml to 0.5 ml per site with an extra 0.1 to 0.2 at the infra-orbital site to block the caudal maxillary alveolar nerve. In cats, the recommended dose is 0.1 to 0.3 ml per site to a maximum of 0.4 ml/kg.

Lidocaine with epinephrine is available in carpules at 2.0% or 20mg/ml. A 1.8cc carpule, therefore, contains a total of 36mg. The maximum dose in dogs is 8mg/kg or 0.4 ml/kg.

Note that the maximum dose for lidocaine is four times the maximum dose for bupivicaine. The concentration of lidocaine is also four times that of bupivicaine. Therefore, the two drugs can be dosed at equivalent volumes.

For very small animals, it may be beneficial to dilute the agent with sterile water to allow an increased

volume of injection while maintaining the very small doses required.

Some advocate mixing marcaine and lidocaine with a touch of morphine all in the same syringe for dental nerve blocks. The theory is that the lidocaine would take effect quickly so you can start surgery, the marcaine would last a long time for prolonged post-op analgesia (or for lengthy surgeries) and the morphine would add some local opiate analgesia. See Dr. Beckman's article for more details on this.

Complications in Local Dental Anesthesia

The placement of local anesthetic nerve blocks is not a risk-free procedure. Intravascular injection and physical trauma to nerves and vessels are real possibilities. Repeated aspiration before and during injection will help avoid the former. Being aware of the anatomy and being gentle with your technique will help minimize the latter.

I have been using local dental nerve blocks for many years now and overall, have been very happy with the results. Some patients, however, seem distressed on recovery following local nerve blocks. I have assumed that they were reacting to the very strange feeling associated with a dental nerve block. It is also possible that there is hyperesthesia due to a traumatic placement. In either case, some dogs and cats will paw at the anesthetized area upon recovery. Commonly, this behavior stops once the animal has recovered to standing. However, staff should be aware of this potential problem and watch animals carefully during recovery to prevent self-mutilation.

Bupivicaine contains epinephrine as the vasoconstrictor. All vasoconstrictors are contra-indicated in patients with unstable cardiac disease, uncontrolled diabetes or hyperthyroidism, steroid-dependent asthma or pheochromocytoma.

Tricyclic antidepressants such as amytryptyline and beta-blocking agents such as propranolol can potentiate the effects of epinephrine. Halothane sensitizes the heart to epinephrine increasing the risk of arrythmias.

Conclusion

Local dental nerve blocks are a great boon to the practice of veterinary dentistry. They are relatively quick and easy to administer and require very little investment in materials and equipment.

Pre-emptive pain management helps animals recover faster and go home happier (which makes the owners happier). With local anesthetic to block sensation, the animal can be maintained at a much lighter plane of general anesthesia which reduces the risk of the procedure.