"ANALGESIA FOR BLOCKHEADS" - DENTAL NERVE BLOCKS FOR TECHNICIANS

Heidi Reuss-Lamky, LVT, VTS (Anesthesia)
Oakland Veterinary Referral Services
1400 Telegraph Road
Bloomfield Hills, MI 48302

Pain management in veterinary patients has become "vogue" only within the last 10 years or so. Contemporary research indicates that when pain is adequately treated in our veterinary patients they recover more quickly and return to normal behaviors (grooming, eating, etc.) sooner, with less morbidity and mortality observed. Additionally, the concept of "preemptive analgesia" has emerged, further improving the quality of pain management we can provide. Preemptive analgesia can be defined as "treating an impending painful stimulus *before* causing the painful event itself." This concept has proven that prevention of "wind-up"–- or the opening of the pain gates -- will result in the need for lower doses of analgesics with a reduced frequency over the course of the painful event. It is important to remember that the drugs used for the induction and maintenance of anesthesia do not provide preemptive analgesia.

Local anesthesia can be defined as "a temporary loss of sensation in a defined part of the body without loss of consciousness." Regional anesthesia is defined as a "loss of sensation of a part of the body by interrupting the sensory nerves conducting impulses from that region of the body," and is often used to describe field blocks or a specific nerve block. The differences between local and regional anesthesia are somewhat arbitrary, but in general smaller volumes of local anesthetics are needed to produce a nerve block versus a regional field block. A nerve block is performed by injecting a small volume (usually less than 1-2 ml) of a local anesthetic in close proximity to a nerve whose conductivity is to be interrupted. [1, 2] The gratification of using many of the following nerve blocks is that precise placement of the agent is not as important as "a close call." The effects occur primarily *by diffusion* of the agent around the nerve, helping ensure success even with virgin attempts.

Local anesthetic agents are classified as either *amides* or *esters*, based on their chemical structure. Lidocaine and bupivicaine are examples of amides, and procaine is classified as an ester. Many local anesthetics produce vasodilation, which can increase the speed of uptake of the drug into the bloodstream. This characteristic decreases the efficacy at the site of injection and can increase the potential for toxic side effects. For this reason, many local anesthetics are combined with a vasoconstrictor (such as epinephrine) to help maintain their concentration at the site of administration and increase the duration of action.

Local anesthetics exhibit their effects by stabilizing the membranes of excitable tissues, thereby preventing the transmission of the nerve impulses. They selectively bind to sodium channels in the nerve membrane at one or more sites.[1] This action prevents the large increase in permeability of the membrane to sodium ions that can occur as a result of a noxious stimulation. They also stop the transfer of the noxious information to the central nervous system, thereby completely blocking pain perception.

Nerve blocks are considered to be the "perfect" analgesic agent as they are the only type of blockade capable of inhibiting 100% of the perception of pain, albeit temporarily. In general, the following nerve blocks are easy to perform, and the supplies needed are inexpensive and readily available. These blocks provide a rapid onset of analgesia and are synergistic with other analgesic modalities, making them an important part of a balanced analgesic and anesthetic protocol. "Balanced" anesthesia *and* analgesia involve the use of multiple drug classes to provide the most effective management of pain and minimize the amount of anesthetic needed. The majority of pain is evident for the first 24-72 hours after dental surgery, necessitating continued pain management once the patient leaves the hospital.[3] Fortunately there are numerous drug options available (such as the synergistic combination of NSAIDs and opioids) that can help to round out a good post-operative pain management plan.

There are numerous benefits for implementing the use of dental nerve blocks. In addition to providing preemptive analgesia and lowering analgesic dose requirements, we can maintain our patients on reduced concentrations of the inhalant anesthetics, thereby minimizing complications from hypotension, bradycardia, and hypoventilation. Patients maintained on lower anesthetic concentrations will recover more quickly and with fewer complications.[4] We can provide a smoother anesthetic episode, as the inhalant will not need to be increased during particularly painful parts of the procedure, such as with tooth extractions. Many patients undergoing anesthesia are elderly and often have pre-existing conditions such as heart murmurs or endocrine dysfunction that increase their risk of anesthesia. Clients have come to expect pain management from veterinary facilities, and they can be comforted by the fact that your hospital can offer advanced pain management.

There are many indications for dental nerve blocks besides mere tooth extractions. These can include bone and soft tissue reconstruction following trauma, mass excisions or biopsies, root canal therapy, oronasal fistula repair, cleft palate repair, periodontal flap surgery, or maxillectomy/mandibulectomy. Essentially they are valuable in any procedure where local pain control would be beneficial.[4]

There are 5 basic dental nerve block areas: the major palatine, infraorbital foramina, maxillary, middle mental, and mandibular (also referred to as the inferior alveolar). Although most authors recommend performing dental nerve blocks using a sterile technique, all blocks should be performed based on the preferences of the attending clinician. <u>With ALL dental nerve blocks, **ALWAYS ASPIRATE** prior to injection of the agent.</u> There is an increased likelihood of blood aspiration during the completion of the block, resulting in an accidental intravenous injection of the local anesthetic. **Always inject the agent slowly.**

Major Palatine Block

The **major palatine** foramen is located on the palate, halfway between the palatine midline and the dental arcade at the level of the mesial root of the maxillary first molar in dogs, and palatal root of the maxillary 4th premolar in cats. The major palatine nerve provides sensory innervation to the oral side of the hard and soft palates. The foramen is not palpable and the needle cannot usually be placed into the foramen. As this area can be difficult to identify, and because the palatine nerve is also a branch-off of the maxillary nerve, performing this block does not provide much of an advantage over the other blocks. Therefore discussion on this block will be limited.

Infraorbital Nerve Block -- Cranial and Caudal

The infraorbital nerve has multiple sensory branches that innervate the nasal and buccal soft tissues as well as the incisor, canine and premolar teeth. In dogs, the foramen is located on the maxilla, dorsal to the caudal (distal) root of the 3rd maxillary premolar. The caudal extent of the infraorbital canal is located at the level of the medial canthus of the eye, which can serve as a guide for maximum needle advancement. When performing this technique on brachycephalic breeds (including cats), use caution to avoid inserting the needle beyond the medial canthus, as the infraorbital canal is rather short as compared to normocephalic and dolichocephalic dogs.[5] The infraorbital block can be performed using 2 different techniques-- cranial and caudal.
The **cranial infraorbital block** desensitizes the incisor, canine and premolar teeth as well as the associated ipsilateral soft tissues. This block is performed at the opening of the infraorbital foramen, using either an intraoral or extraoral approach. The nose of the patient should be somewhat elevated during the injection, to help encourage caudal flow of the local anesthetic. The needle should NOT be inserted deep into the infraorbital canal, and injection of only a small amount of local anesthetic (usually 0.25-0.5 ml) is necessary.[*] Once the local anesthetic has been injected, apply pressure over the injection site for 60 seconds while the head remains elevated to encourage caudal flow of the local anesthetic agent.

The **caudal infraorbital nerve block** desensitizes the entire area indicated above, plus all of the bone, soft tissue, and dentition rostral to the maxillary first molar. The area affected by this block depends greatly upon the degree of caudal diffusion of the anesthetic agent. Unless the agent diffuses beyond the caudal borders of the infraorbital canal, adequate analgesia cannot be provided to the maxillary 4th premolars and molars. Therefore, it is recommended that if anesthesia to the caudal cheek teeth is desired, then the maxillary nerve block should be performed instead.[4] The caudal infraorbital nerve block is performed identical to the cranial infraorbital nerve block while the head is elevated, with the exception of using digital pressure over the foramen and needle *during* injection of the agent. This helps to force the local anesthetic caudally, and elevating the head post-injection while placing direct digital pressure over the infraorbital canal for 60 seconds helps to further encourage caudal flow of the agent deep into the infraorbital canal. An additional 50% of the local anesthetic can be administered for the caudal infraorbital nerve block to encourage adequate diffusion to the middle superior alveolar nerves that lie within the infraorbital canal. [4]

In cats, the infraorbital foramen is located above the maxillary 2nd premolar, and is within the junction of the zygomatic arch and maxillary bone. The infraorbital canal is only about 4 mm long in a mature cat, and ends at the level of the medial canthus. The needle is placed into the foramen and advanced into the infraorbital canal for a maximum of 3-4 mm.[3] It is still important to maintain pressure over the site for up to 60 seconds post-injection. Furthermore, excessive

[*] Although some experts will describe techniques involving insertion of the needle deep into the foramen, the techniques described within this text will involve “nerve friendly” methods to decrease the likelihood of nerve damage during performance of the blocks.

pawing of the face can be observed during recovery in cats administered mandibular and/or infraorbital foramen nerve blocks.

Maxillary Nerve Block

The following techniques for performing the **maxillary nerve block** in dogs and cats have not yet been reported in the literature. These simple techniques were pioneered by Benjamin Colmery, DVM, AVDC, during his tenure at the Animal Medical Center in New York, and were the result of careful study of the cranial anatomy of dogs and cats. The maxillary nerve block affects all of bone of the maxilla (soft and hard palates), nose and upper lip (soft tissue), and dentition rostral to the maxillary first molar (i.e., the entire hemi-maxilla). Additional drug quantities (up to 2 ml in very large breeds) can be used to flood this nerve for desensitizing the orbit, eye, conjunctiva, eyelid and forehead skin.[6]

In dogs, the maxillary nerve block is performed by inserting the needle just caudal and center to the last maxillary molar. Advance the needle dorsally to a level just beyond the root tips of the last molar, then aspirate and slowly inject the agent. This technique is preferred over the infraorbital nerve block for providing analgesia to the maxillary molars.[6]

In cats, the maxillary nerve block is performed at the base of the 'V' notch or divot near the soft palate juncture, palpable just medial to the caudal root tips of the maxillary 4th premolar. Aspirate and inject slowly.[6]

Middle Mental Block -- Canine

The **middle mental nerve block** disrupts sensation to all of the ipsilateral canine and incisor teeth, bone and soft tissue rostral to the 2nd premolar of the mandible. If the agent is deposited outside of the foramen, only the ipsilateral buccal soft tissue from the canine teeth forward will be desensitized.[7] This block can be performed either intraorally or percutaneously. The foramen is easily palpated in larger dogs, but can vary in location with breed, size and species of the patient. Dental radiology may be beneficial in locating this foramen in small breeds of dogs and cats. In dogs, the middle mental foramen is located ventral to the rostral (mesial) root of the 2nd premolars. If the area cannot be palpated, then place the needle in the submucosa at the ventral 1/3 of the mandible, at the level of the diastema between the first and second mandibular premolars. A finger should be placed over the needle during the injection to help direct the anesthetic into the foramen. As the agent is injected directly into the canal, pain may induce a rise in the heart rate, unless the agent is injected very slowly. Remember to hold digital pressure over the injection site for 60 seconds post-injection to ensure maximum caudal diffusion of the agent into the foramen.[4]

Middle Mental Block -- Feline

The middle mental foramen is very small and difficult to locate in cats, making this block troublesome to place. The foramen location is at (or immediately caudal to) the apex of the mandibular canine tooth, and the targeted foramen is located most rostrally.[3] This block is performed as described above for the dog, but using a 27-gauge needle may allow easier access into smaller foramina. The middle mental nerve block provides limited analgesia to a limited part of the mandible, making the mandibular nerve block perhaps a more practical alternative in this species.[6]

Mandibular/Inferior Alveolar Nerve Block

The **mandibular nerve block** desensitizes the lower dental arcade to include teeth and bone on the ipsilateral side as well as the associated soft tissues (including the tongue) that are innervated by the mandibular nerve (i.e., the entire hemi-mandible).[7] This block can be performed either intraorally or extraorally. The mandibular nerve fossa can be easily palpated intraorally in most dogs. Intraoral palpation of the needle during injection of the local anesthetic can help ensure proper needle placement.

The foramen is located on the medial side of the ramus of the mandible. Since this foramen cannot be directly entered, this nerve is blocked before it enters the mandible. Analgesia is accomplished secondary to regional diffusion of the local anesthetic. Ensure that the bevel of the needle is facing the foramen when performing this block, then aspirate and inject slowly. Caution must be used when performing this block, as inadvertent inclusion of the lingual nerve can cause self-mutilation of the tongue and lip-chewing upon recovery, requiring sedation of the patient until the agent disperses. Again, please note that excessive pawing of the face can be observed during recovery in cats administered mandibular and/or infraorbital foramen nerve blocks.

Splash Block

Placement of a local anesthetic directly into a surgical site or injected into a closed space where the agent may diffuse is another technique that may be used for local pain control in oral surgery.[5]

Performing the Blocks

Supplies necessary to perform dental nerve blocks include tuberculin or 3 cc syringes, 30-22 gauge, ¾--1 3/8 inch needles, and a regional anesthetic agent. The most commonly used agents include lidocaine, mepivicaine, and bupivicaine. The addition of epinephrine reduces the rate of absorption of the local anesthetic by about 30%, and can increase the effect and duration by up to 50%.[2] Epinephrine will also aid in hemostasis. The most commonly used dental block agent is 0.5% bupivicaine combined with epinephrine 1:200,000 (Abbott Laboratories). This preparation is also available in 1.8 ml individual dose cartridges that can be used with dental aspirating syringes. In general, the volume administered <u>per site</u> should range anywhere from 0.1-0.5 ml for dogs (depending on body size), and 0.1-0.3 ml for cats. **When using bupivicaine (with or without epinephrine) the maximum "total body" dose for dogs is 2 mg/kg, and the maximum "total body" dose for cats is 1 mg/kg.** ***Extreme caution should be used when blocking multiple locations in smaller patients to ensure that toxic doses are not exceeded!*** Local anesthetics may be diluted with 0.9% NaCl (NOT sterile water) if necessary to provide additional volume and avoid toxic doses.[2]

	Lidocaine 2%	Mepivicaine 1-2%	Bupivicaine 0.5%
Infiltration Dose:			
Canine	5 mg/kg	5 mg/kg	2 mg/kg
Feline	2.5 mg/kg	2.5 mg/kg	1 mg/kg
Onset -- Minutes	10	5	20
Duration – Hours	1-2	2-3	3-6
Toxic Dose	10 mg/kg	30 mg/kg	4 mg/kg

Dr. Stephen A. Greene, DVM, MS, Diplomate, ACVA
Washington State University, Pullman, WA

Toxicity and Complications of Local Anesthetics

Systemic toxicity to local anesthetics is rare, but can result in central nervous system (CNS) signs that include muscle twitching, seizure, depression, unconsciousness, coma and respiratory arrest. It is important to note that these signs can be masked in the anesthetized patient. Treatment of CNS toxicity is supportive.

Bupivicaine dissociates slowly from sodium ion channels, making this drug more cardiotoxic than lidocaine or mepivicaine. Bupivicaine-induced cardiovascular dysfunction causes profound depression of the cardiac-conducting tissue, resulting in decreased cardiac output and systemic hypotension leading to cardiovascular collapse/arrest. Cardiac toxicity is greater in the presence of hypoxia, acidosis, and hyperkalemia. Cardiovascular toxicity resulting from bupivicaine is difficult to treat unless addressed promptly, and consists of supportive care that can include intravenous fluids, vasopressors and positive inotropes. If epinephrine was combined with bupivicaine, tachycardia, bronchospasm, or dysrhythmia may result.

Metabolites or preservatives of local anesthetics can also cause rare allergic-type reactions.[1] The most common indicators of anaphylaxis are cutaneous and respiratory reactions, which are often secondary to accidental intravenous injection or excessive doses of local anesthetics. Methemoglobinemia is also possible.[8]

Complications resulting from oral nerve blocks performed on humans and reported in literature include hematomas, iatrogenic tissue trauma, and broken small gauge needles.[3] Although extremely rare, permanent damage to the inferior alveolar nerve, lingual nerve, or both can occur as a result of mandibular nerve blocks. Neurologic complications can include facial nerve palsy, transient blindness, Horner’s syndrome, transient nerve paralysis, and unilateral deafness. Local anesthetics are avoided in human patients prone to malignant hyperthermia, so it may be prudent to avoid them in this group of veterinary patients. [4]

Contraindications for epinephrine usage include uncontrolled hyperthyroidism, cardiac dysrhythmias, and asthma. Additionally, halogenated agents can sensitize the heart to catecholamines. Mepivicaine or bupivicaine alone can be substituted if bupivicaine with epinephrine is contraindicated.[3]

In conclusion, dental nerve blocks are inexpensive to perform, easy to master, and have a significant impact on patient comfort. They can become an invaluable part of a balanced anesthetic protocol when combined with other analgesic modalities.

Dentition Formula Review:

Canine- $\frac{\text{I 6 C 2 P 8 M 4}}{\text{I 6 C 2 P 8 M 6}}$ = 42 teeth

Feline- $\frac{\text{I 6 C 2 P 6 M 2}}{\text{I 6 C 2 P 4 M 2}}$ = 30 teeth

Glossary:

Buccal -- pertaining to or directed towards the cheek
Diastema -- space
Distal -- away from the center line of the dental arch
Foramen -- natural opening into or through a bone (pl. Foramina)
Frenulum -- where lip attaches to bone
Ipsilateral -- affecting the same side
Labial -- pertaining to a lip
Lingual -- pertaining to or towards the tongue
Mandible -- bone of the lower jaw
Maxilla -- upper jaw bone; includes floor of the orbit, side and lower walls of the nasal cavity, palate, and teeth
Mesial -- toward the center line of the dental arch
Palatine -- pertaining to the palate
Ramus -- vertical portion of the caudal mandible
Rostral -- towards the nose

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