Advanced dental local nerve block anesthesia

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Introduction

Pain control during and after dental procedures in dogs and cats is critically important for the animals and clients. Much reliance is placed on local nerve blocks to achieve the desired pain control. Knowledge of pre-emptive analgesia, local anesthetics, and landmarks that guide the injection of the anesthetics to the appropriate sites is needed for success in providing satisfactory nerve blocks.

Pre-emptive analgesia

Placing local anesthesia under general anesthesia before a painful stimulus occurs is termed "pre-emptive analgesia" (1). Pre-emptive analgesia prevents both the sensitization of the pain pathways, and the release of peripheral chemicals, such as histamine and neuropeptides, which are harmful to tissues and retard tissue healing (2).

Pre-emptive analgesia 1) prevents pain — pain increases circulating catecholamines which push the animal into a detrimental negative catabolic state (2); 2) reduces intra-operative pain, lessening the need for deep anesthesia (1); 3) reduces hypoventilation noted with higher gas concentrations; 4) reduces vagally mediated reflex bradycardia; 5) reduces hypotension; 6) allows for pain control with a **lower total dose** of analgesics (note: this does not eliminate the need for post-operative analgesia) (1); 7) can provide post-operative analgesia for 6 to 8 h (bupivicaine).

These positive effects combined make for a safer anesthetic and a faster and less eventful recovery. Lowering the inhalant anesthetic required will save the practitioner money. Clients expect that analgesia will be used. The explanation of the use of pre-emptive analgesia to your clients and the benefits to their precious pet will set your practice apart from those who may not be as knowledgeable or progressive.

Local anesthetics

One of the first local anesthetics was **cocaine** (3). In 1884, Karl Kollar, a colleague of Sigmund Freud, used cocaine as a topical ocular anesthetic (3). Because of its addictive properties, a cocaine analog, **procaine,** also known as **Novocain,** was synthesized in 1905 (3). Novocain had an intermediate length of time to produce the desired result, wore off quickly, and was much less potent than cocaine (4). It is also an ester with a high potential for causing allergic reactions (4), which it did in about 1/3 of the population receiving this drug (3). Nitrous oxide gas and whiskey subsequently became the main sources of pain control during dental procedures for humans (3).

The first modern local anesthetic agent, **Lidocaine,** was initially produced in the 1940's (3). It is an amide and, as such, is hypoallergenic (3). Lidocaine is the most widely used local anesthetic agent in small animal practice (4); however, its vasodilatory action causes it to be absorbed too quickly (3). Lidocaine takes effect quickly after administration, but is of short duration, producing numbness which lasts only about 60 to 120 min (2). In order to prevent increased toxicity from rapid absorption, lidocaine is combined with a low concentration of epinephrine which causes vasoconstriction. This keeps the anesthetic in place long enough to take effect. **The total maximum safe dose for the canine patient is 5 to 6 mg/kg body weight (BW) and for the feline patient 1 to 3 mg/kg BW** (5,6).

Mepivicaine and **prilocaine** can be used without epinephrine as they have less vasodilative properties (3). These anesthetics have an advantage for patients on non-selective beta blockers and tricyclic antidepressants such as Elevil, which would interact negatively with a vasoconstrictor (3). Another advantage is that carpules without the vasoconstrictor do not have preservatives in them, and thus potential allergic reactions to the preservative are avoided (3).

Bupivicaine (Marcaine) produces very long anesthesia, lasting 4 to 6 h (4), but it has a high pH and takes 5 to 30 min after administration to take effect. During this time, however, intraoral radiographs may be taken or the mouth could be charted. If one proceeds before the local anesthetic has a chance to take effect, the reasons for using pre-emptive analgesia are negated, and the wind-up phenomenon commences. [The windup phenomenon is the buildup of chemical mediators that intensify the pain response (1). The animal will not be aware of pain until it regains consciousness (1)]. Bupivicaine is the most toxic of all anesthetic agents and this toxicity is reflected in the low concentration of the carpules (0.5%) (3). **The maximum total safe dose is 2 mg/kg BW (4).** The recommended **volume** for local dental nerve blocks at 0.5% for dogs is 0.1 to 0.5 mL/site with 0.1 to 0.2 mL extra for an infraorbital nerve block to anesthetize the maxillary molars; for cats this volume is 0.1 to 0.3 mL/site (7). A bupivicaine carpule holds 1.8 mL,

Figure 1. Feline skull – intraoral maxillary nerve block.

Figure 2. Canine skull – intraoral maxillary nerve block.

but an estimate must be made for the volume administered, as the carpule is not graduated. A graduated syringe should be used for accuracy and to prevent over-dosage in patients weighing < 2 kg.

Articaine (Septocaine) is the newest addition to the local anesthetic family and is one of the most common local anesthetics used in human dentistry (8). It has been in use in Canada since 2001. It comes in a 4% solution with a vasoconstrictor which slows the systemic absorption allowing more of the drug to remain in the area of injection. Articaine produces profound anesthesia and has a quick onset. One complication of this anesthetic in humans is unexplained paresthesia in a low percentage of patients in tissues previously anesthetized with articaine (3,8).

Local anesthetic agents work by entering and occupying ion channels in a nerve cell membrane, preventing depolarization (5). This retards the conduction of pain impulses. All modern local anesthetics are metabolized by the liver except articaine, which is metabolized in the blood (8).

If epinephrine, a vasoconstrictor, is added to the local anesthetic, it will reduce hemorrhage and prolong the activity of the local anesthetic (8). It will also delay the absorption of the anesthetic systemically and thereby reduce anesthetic toxicity (8). Sodium beta bisulfate is used as a preservative in the cartridge for the vasoconstrictor; however, it may cause allergic reactions (8). Sulfites found in salad bars, red wine, and nuts can induce allergic reactions in humans which include rashes, inability to breathe, loss of bowel control, reduction in blood pressure, and swelling. These allergic reactions are treated with epinephrine. The amount of epinephrine in the carpules is miniscule; more epinephrine enters the blood from anxiety than from the vasoconstrictor in a cartridge (8).

Administration of local anesthetics

When administering a local nerve block always withdraw to avoid an intravascular injection. An intravascular injection of local anesthetic agent reduces cardiovascular function (5,8). The myocardium is adversely affected with reduced electrical excitability, conduction rate, and force of contractions (8). A human will develop palpitations and blanching of the face with an intravascular injection of local nerve anesthetic (8). Veterinary patients will experience cardiac arrhythmias, hypotension, vasodilation, and tremors (2,5). There is a higher failure rate of being able to aspirate blood when using a smaller gauge needle. A 30-gauge needle, for example, will have a 97% failure rate, whereas a 25-gauge needle will have a 2% failure rate (9). Thus, a 25-gauge needle is more effective for blood aspiration in order to avoid an intravascular injection.

Inject the block slowly to reduce pain (8). If the patient is under a light general anesthesia, it will react to the pain of the nerve block. With intraoral inferior alveolar nerve blocks, place a syringe case mouth gag between the upper and lower canine teeth to try to protect your hands while administering this block, even under general anesthesia.

If the needle is too short or too thin it may not penetrate to the nerve site or it may be deflected by tissues (8,10). For example, a 30-gauge needle will deflect 4 mm, whereas a 27-gauge needle will deflect 2 mm (8). If the needle is rotated while injecting, the tissues will not deflect (8). Some needles are double beveled and do not deflect tissues at all (11). When using infraorbital nerve blocks, pressure should be applied for about 1 min after the needle has been withdrawn to force the agent into the canal.

Other complications of local nerve block injections include hematoma at the injection site, ischemia distal to the injection site, localized infection spread along the needle tract, and a reduced effect in the face of purulent material at the injection site. The infected material is acidic, which neutralizes the basic pH of the anesthetic (8). Skeletal and neuro-anatomical variations among animals may reduce the effectiveness of the nerve block administered. Local anesthetic toxicity occurs if

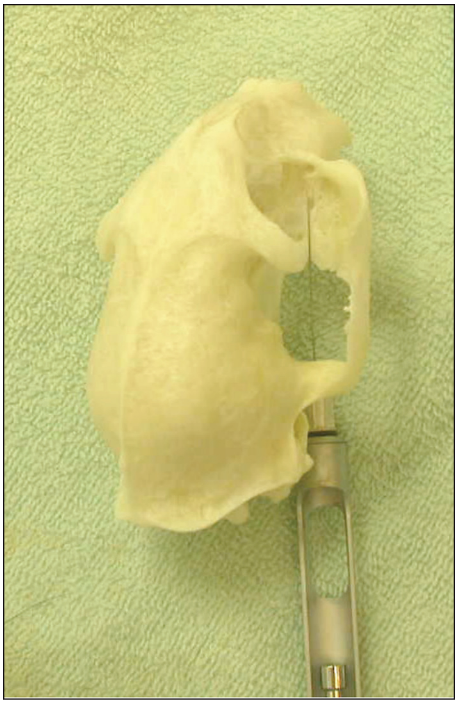

Figure 3. Feline skull – extraoral, intraoral maxillary nerve block.

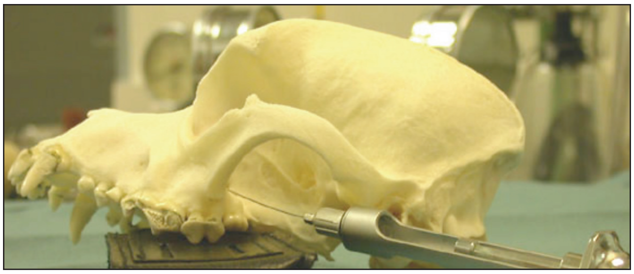

Figure 4. Canine skull – extraoral, intraoral maxillary nerve block.

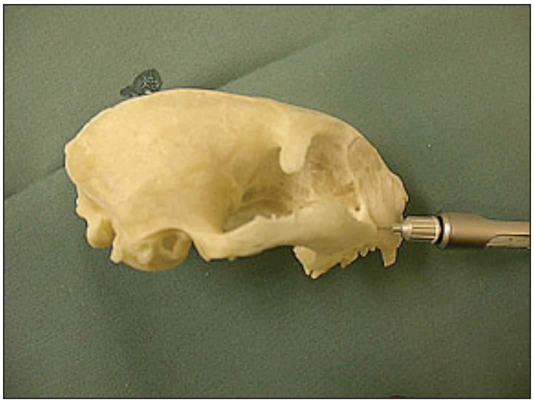

Figure 5. Feline skull – infraorbital nerve block.

Figure 6. Canine skull – infraorbital nerve block.

the drug is administered too quickly, if too much is given, with very young or very old patients, or if liver function is compromised (8).

Sensory input to the oral tissues is primarily from the trigeminal nerve, cranial nerve 5 (12). The maxillary division is comprised of the major and minor palatine nerves, caudal maxillary alveolar nerve, middle maxillary alveolar nerve, rostral maxillary alveolar nerve, and the infraorbital nerve (12). The maxillary division leaves the trigeminal ganglion, exits the cranium through the foramen rotundum, goes through the alar canal, crosses the pterygopalatine fossa, and enters the infraorbital canal (12). The major and minor palatine nerves which innervate the hard and soft palate and the nasopharynx are desensitized with the **maxillary nerve block.** This is used when major pain control is desired. The caudal maxillary alveolar nerve (innervates the maxillary molar teeth, the associated buccal gingiva, and buccal mucosa), the middle maxillary alveolar nerve (innervates the pre-molar teeth and the associated buccal mucosa), the rostral maxillary alveolar nerve (innervates the canine and incisor teeth, and the buccal gingival), and the infraorbital nerve (innervates the dorsal cutaneous structures of the rostral maxilla and upper lip) are all desensitized with the **infraorbital nerve block.**

The landmarks to administer a **maxillary nerve block** are as follows (13):

Intraoral — Consider 2 imaginary lines 1 perpendicular to the palatine mid-line, through the center of the upper fourth pre-molar (tooth 108/208) and the other parallel to the palatal mid-line, halfway from this midline to the dental arch (Figures 1, 2).

Extraoral intraoral — The needle is placed dorso-caudally, 90° mesiad, ventral to the border of the zygomatic arch and approximately 0.5 cm caudal to the lateral canthus of the eye (Figures 3, 4).

The landmarks to administer an **infraorbital nerve block** are intraoral and are as follows (12). Palpate the foramen as a depression in the alveolar mucosa, apical to the maxillary third pre-molar (tooth 107/207). The needle is placed rostro-caudally to the entrance of the foramen (Figures 5, 6). This will desensitize all dentition, labial/buccal bone, and soft tissue in 1 maxillary half.

The mandibular division is comprised of the sensory buccal nerves, lingual nerve, mandibular or inferior alveolar nerve, and the mental nerve (12). The mandibular division leaves the trigeminal ganglion, exits the cranium through the foramen ovale and divides into the above mentioned nerves (12). The sensory buccal nerves which innervate the facial musculature, skin, mucosa of the cheek, and buccal gingiva along the posterior mandible are desensitized with a **buccal nerve block.** The

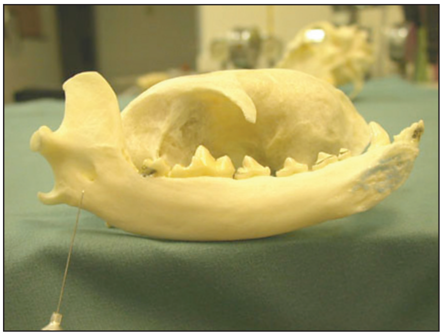

Figure 7. Canine skull – inferior alveolar nerve block. Note that this is the medial surface of the mandible.

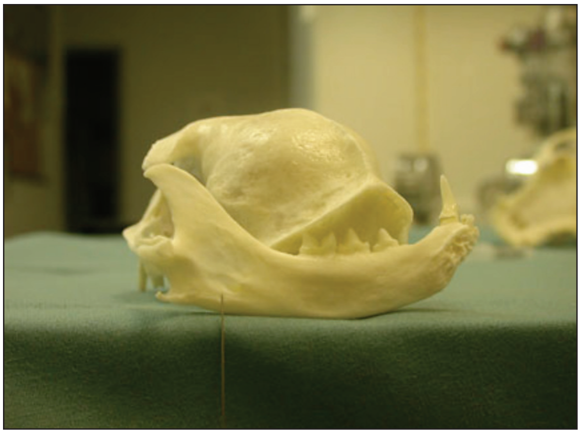

Figure 8. Feline skull – inferior alveolar nerve block. Note that this is the medial surface of the mandible.

Figure 9. Intraoral administration of the inferior alveolar nerve block in a cat.

Figure 10. Intraoral administration of the inferior alveolar nerve block in a dog.

lingual nerve which innervates the tongue, floor of the mouth, lingual gingiva, and the sub-mandibular salivary gland is desensitized with the **inferior alveolar nerve block.** The mandibular or inferior alveolar nerve enters the mandible on the lingual side via the mandibular foramen. It innervates the mandibular teeth to the midline and is desensitized with the **inferior alveolar nerve block.**

The mental nerve innervates the cutaneous areas of the chin, lip, rostral buccal gingiva and mucosa. It is located at pre-molar 2 (tooth 306/406) in the canine or pre-molar 3 (tooth 307/407) in the feline and is desensitized with the **mental nerve block.** Note that this block will not desensitize the canine or incisor teeth.

Landmarks for the **buccal nerve block** are intraoral and the needle is placed sub-mucosally, buccal and apical to the most distant molar tooth (13).

Landmarks for the **inferior alveolar nerve block** (desensitizes all dentition, mandibular bone, lingual soft tissues, and half the tongue in 1 mandibular half) are given below (7).

Extraoral

Canine. Insert the needle perpendicular to the ventral border of the mandible, in the center of the notch on the ventral border of the mandible, cranial to the angular process (Figure 7). This corresponds with the approximate mid-point of the zygomatic arch, just caudal to the lateral canthus. Walk the needle along the medial border of the mandible to the line bisecting the dorso-ventral width of the mandible.

Feline. There is no notch. Insert the needle at the mid-point of the zygomatic arch, just caudal to the lateral canthus (Figure 8). Note: inserting the needle too distal in the retromandibular area will result in facial nerve anesthesia and the patient will be unable to blink on the affected side.

This block can be administered intraorally by extrapolating the above landmarks (13) (Figures 9, 10).

Some veterinary dentists have reported a small number of cases in which animals receiving the inferior alveolar nerve block had chewed off part of their desensitized tongue. This appears to be uncommon and, is reported in Tranquilli's pain management handbook (5).

Landmarks for the **mental nerve block** are intraoral and are as follows (6). Aim for the **middle mental foramen** which is the largest of the 3 foramina. This is palpable only in the larger breeds.

Canine. Place the needle apical to pre-molar 1 & 2 (teeth 405,406/305,306) in a horizontal plane, 2/3 the distance ventrally from the dorsal mid-line border (Figure 11).

Feline. Direct the needle to the center of the diastema between the lower canine (tooth 404/304) and the pre-molar 3

Figure 11. Canine skull – mental nerve block. This is the lateral surface of the mandible.

Figure 12. Feline skull – mental nerve block. This is the lateral surface of the mandible.

Figure 13. Dental syringe and needle.

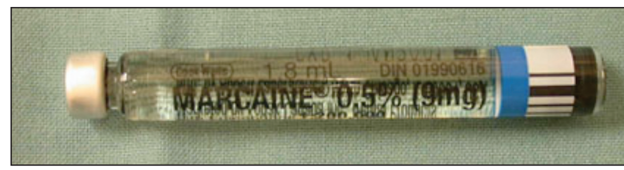

Figure 14. Marcaine carpule.

(tooth 407/307) at the dorso-ventral mid-point of the mandible (Figure 12). This is covered by the mandibular labial frenum. Only go sub-mucosally to avoid neurologic trauma.

Administering an intraoral **local infiltrative block** is only effective in areas where there is thin cortical bone allowing passive diffusion through the bone such as is found in the maxilla, mandibular incisors, and palatal soft tissues. Infiltration is around the apex of the tooth and desensitizes just the local area. The duration of anesthesia is short, 5 to 10 min only, and extreme care is required to avoid the vessels within the vascular bone. The dose must be administered carefully to avoid toxicity related to the vascular space (8). In the face of periodontal disease care is required to avoid transmitting infection into the bone (8).

Periodontal ligamentous injections require specific syringes which are fairly expensive, and reduce the blood supply to the tooth. These injections should only be used in teeth where standard endodontic therapy or extractions are to be performed (8).

Instrumentation to administer local nerve blocks can be quite simple from a tuberculin syringe and a 25- to 27-gauge 1.5-inch needle to a dental syringe with a dental needle 21- to 41-mm long and a 25, 27, or 30 gauge (Figure 13). The advantage in using a dental syringe is that aspiration and injection can be accomplished with one hand. Note that dental needles screw into the dental syringe assembly and penetrate the carpules similar to how a vacutainer needle penetrates the vein and blood tube. Thus, regular needles cannot be used in a dental syringe. Anesthetic agents may be purchased in multi-use vials or in carpules that fit into the dental syringe.

In summary, for success with local nerve block usage in veterinary dentistry one must consider: 1) knowing the anatomy and landmarks of the patient/species, 2) using vasoconstrictors, 3) care with dosages and volumes, 4) using longer, thicker needles, 5) waiting after administration, 6) avoiding intravascular injections, 7) injecting slowly, and 8) insuring liver function is adequate to metabolize the anesthetic.

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