Regional Anesthesia and Pain Management for the Oral Surgery Patient

Christopher Snyder, DVM, DAVDC
University of Wisconsin
Madison, WI

Regional anesthesia and pain management are fundamentally important skills to leverage successfully in dentistry and oral surgery patients. Despite these patients being under general anesthesia while undergoing procedures, there are inherent benefits to practicing techniques that will allow for the reduction of inhalant anesthesia, improve recovery and improve the patient's comfort at the time of discharge. Anatomy of the face and mouth is complex. There are many locations and combination of locations where local anesthetics can be administered which will result in regional anesthesia.

Regional anesthesia can offer many benefits by reducing the animal's response to painful stimuli during the procedure as well as provide postoperative analgesia. Primarily speaking, benzodiazapines, phenothiazines and general anesthetics have no primary analgesic activity. These medications alter the state of consciousness and abolish the perception of pain. Peripheral sensitization, or a reduction in the threshold necessary for stimulus transduction occurs due to the effects of tissue injury and inflammation. Inflammatory mediators including prostaglandin E_2, bradykinin, neurotrophic factors (NGF) and the activation of mast cells contribute to peripheral sensitization. These inflammatory mediators lower the activation threshold and increase the amount of Na^+ flowing across the channel. Once the general anesthetic medications are metabolized, the patient is vulnerable to the sensation of pain.

Local anesthetics work by inhibiting transmission through their effects on Na^+ channels. By preventing depolarization and propagation of neural signals to the brain, pain can be effectively blocked. While local blocks reduce the amount of perceived pain and amount of required general anesthesia and associated unwanted side effects, the patient's comfort can be improved. Effective local blocks are not a replacement for safe, effective general anesthesia. The addition of local blocks to the anesthesia and analgesia protocol will provide the benefits of polypharmacy which are threefold. These drugs prevent peripheral and central sensitization, reduce the adverse effects associated with larger doses of medication and provide better postoperative pain management to smooth out the recovery of the patient.

Studies measuring minimum alveolar concentration have shown that administration of local anesthetics reduce the amount of inhalant necessary to keep 50% of patients asleep during a given stimulus. The use of local anesthetics preventing the propagation of nerve impulses may be beneficial on its own but may be further improved through the addition of opioids or alpha2 agonists administered locally.

When given as a local anesthetic, the lidocaine family of drugs provides a variety of options with different onsets of action and different durations of action. Doses should not exceed 5mg/kg in dogs and 2 mg/kg in cats. Lidocaine is commonly used in human regional and local anesthesia because a quick onset and short duration of action is desirable. Compliance with human patients for taking oral medications is quite good and return to function (frequently the workplace) is important. In veterinary patients bupivacaine is a popular medication choice because of its longer duration of action. Depending on placement the duration of action may be 6 to 10 hours. Time to onset of action is longer than lidocaine, some texts referring to a 20-minute period necessary before the nerve impulses are effectively blocked.

Using the techniques covered in this presentation, it has been the experience of the speaker that small dosages are sufficient to achieve the desired result of local blockade. Using the techniques discussed, the entire mouth can be anesthetized through the administration of local anesthetic in only four locations.

Bupivacaine

- 0.1-0.15mL per site (cat or small dog)
- 0.2mL per site (medium dog)
- 0.3mL per site (large dog)

The various blocking locations are listed below.

- Infraorbital block
    - Location: immediately within the infraorbital canal
    - What it blocks: maxillary incisors, canine tooth, premolars 1-2, +/- 3, buccal mucosa, ipsilateral lip, ipsilateral soft tissue of that side of the face
    - What it won't block: palatal mucosa, PM4 (commonly extracted), may not completely anesthetize for extraction of the central incisors due to crossover innervation
- Caudal maxillary block
    - Location: advance the needle parallel with the hard palate trough the infraorbital canal to approximately half the length of the zygomatic arch

    - What it blocks: all the maxillary teeth in that quadrant, ipsilateral lip, ipsilateral hard/soft palatal mucosa, ipsilateral soft tissues on that side of the face
    - What it won't block: may not completely anesthetize the central incisors
- Middle mental block
    - Location: ventral to the mesial root of the 2nd premolar. Enter in through the mesial aspect of the labial frenulum and place the needle against periosteum half the height of the mandible and centered over the tip of mesial root of the second premolar
    - What it blocks: ipsilateral lip and rostral soft tissues, incisors? and canine tooth?
    - What it won't block: Questionable coverage for the ipsilateral mandibular incisors and canine tooth (probably due to diffusion into the mandibular canal)
- Caudal mandibular block
    - Location: two main approaches
        - Half the distance between the angular process and the mucosa immediately caudal to the third molar (lingual side of the mandible)
        - Palpate the ventral notch of the mandible, half the distance of the length of the notch, place needle perpendicular to the notch and immediately on the lingual surface, advance needle ½ to 1 cm
    - What it blocks: all ipsilateral mandibular teeth, rostral mandibular soft tissues
    - What it won't block: questionable coverage for caudal mandibular soft tissues, if applied correctly, should not risk anesthetizing the tissues of the tongue

Once the needle has been placed, it is important to aspirate and re-aspirate while rotating the needle 90^{o} along the long axis to ensure the injection is not given intravascular. Medication should be administered with the needle being placed on periosteum for the middle mental, and caudal mandibular blocks. Even if the bevel is not directly over the nerve, by being deposited on periosteum, the local will cover more surface area and increase the chance that the nerve will be coated. Once the local has been administered, the needle should be withdrawn and digital pressure should be placed for 1 minute to provide adequate time to prevent hematoma formation.

There is reasonable expectation that the addition of opioids to a local block may improve postoperative analgesia long after the effects of the sodium channel blockade wear off. In a double blinded human study looking at the addition of an opioid to a local anesthetic, 50% of patients reported they did not take rescue oral pain medication 36 hours after minor oral surgery. This study's evaluation period ended at 48 hours. Of the patients who only received the local anesthetic, 100% of them were reportedly taking rescue oral pain medication 12 hours after the procedure. It has been well established that *mu* receptors exist in the peripheral nervous system and are upregulated when exposed to chronic noxious stimulation. Dentistry patients undergoing procedures for acute injuries, such as tooth fracture, are less likely to demonstrate the benefits of opioids in their local blocks as compared to cats with stomatitis or tooth resorption. Chronic conditions may make some drugs work better or last longer. Chronic conditions and chronic inflammation can also be associated with a pH shift towards being more acidic which, when coupled with the pKa of the local anesthetic, may prevent the local from being lipophilic. In cases of generalized oral inflammation, the local should be administered in locations targeting the nerves far from the clinical manifestation of the inflammation.

There are several situations where long term desensitization of a surgery site may be undesirable. Patients suffering from an oronasal fistula already have a loss of bone and a communication between the oral and nasal cavities. Repairing these defects and having the surgery site be completely numb may result in the animal becoming preoccupied with feeling the sutures on their tongue and subsequently tongue thrusting through the surgery site up into their nasal cavity. Similar potential situations exist with maxillectomy patients. It is the speaker's experience, and recommendation that using short acting local anesthetics like lidocaine followed by aggressive post operative pain management will result in a comfortable patient after surgery with decreased risk of tongue thrusting. Tongue procedures should never receive local block administration because these patients will be at very high risk of self trauma and risk "chewing their tongue off." Use of large volumes when performing local blocks has also been anecdotally reported in resulting in this form of self-mutilation. Sticking with the small volumes and accurate placement afford good results with decreased risk.

Whenever there is potential for the local block needle to traverse through an area of possible neoplasia, this procedure should not be performed. Seeding tumor cells through the infraorbital canal may extremely complicate treatment options available for a maxillary tumor. Using a 25 gauge 1 inch to 27 gauge 1.5 inch needle helps reduce possible nerve injury.

Opioids

Opioids are used as the gold standard for centrally acting analgesics. Sensory neurons, found in the periphery have also demonstrated an analgesic response to opioid medications. Peripheral *mu* opioid receptors are found to be upregulated in situations of chronic pain or inflammation. The addition of opioids have been proven to prolong the duration of action in both peripheral extremity nerve blocks threefold (extending duration from a mean of 6 hours to greater then 30 hours) and has also been demonstrated to be beneficial in

human oral surgery patients. The mechanism of activity for these opioids to enhance analgesia is associated with the upregulation of *mu* receptors in the peripheral nervous system. The addition of opioids to the local block binds those peripheral receptors with minimal effects on the central nervous system. Likewise, the administration of oral, intramuscular, intravenous or subcutaneous medications has a primary responsibility or role of activity by binding *mu* receptors in the central nervous system and having little impact peripherally. The author believes he has seen an improvement in postoperative pain control in patients who receive a combination of local anesthetic with the addition of the opioid buprenorphine (0.05mL per patient).

Complications

Complications with local anesthetic blocks have been reported in the literature. Paraesthesia, altered sensation and motor changes are occasionally reported anecdotally from practitioners. It is unclear as to where the origin of nerve injury associated with local anesthesia comes from. While histologic nerve changes associated with local anesthetic administration are reported in veterinary patients (Correspondence: J Anthony), true clinical significance should be considered since similar blocks have been performed in humans for decades with a low incidence of true complications. Peripheral nerve paresthesia is a rare complication reported in humans. A human dental textbook states it reportedly occurs 1 case in 1 million injections. Peripheral nerve paraesthesia and subsequent self mutilation of the veterinary patients' tongue has been only anecdotally reported. The technique for proper needle placement for local anesthetic placement is different then it is for venapuncture. After initial needle penetration, the needle should be guided into position for local administration. When these needles are guided through foramen (as in the infraorbital or caudal maxillary blocks) the needle should be advanced slowly and in most situations the needle bevel with help to displace the neurovascular bundle as the bevel is advanced. Nerves penetrated by needle placement can have variable effects- from no change to permanent sensory or motor dysfunction.

There is a school of thought that nerve injury associated with local blocks may not be directly related to physical damage by needle placement. Peripheral nerve ischemia associated with the addition of epinephrine to a local block may also be associated with nerve injury. The addition of epinephrine to long acting local blocks has therefore been recommended against for that very reason. Beyond the delayed absorption of local anesthetics by the vasoconstriction associated with epinephrine, it has been shown that this catecholamine has some alpha-2 agonist analgesic activity.

The use of small doses in regional anesthesia and aspiration immediately after needle placement can help avoid inadvertent intravascular injection. The most common complications with intravascular injections of local anesthetics include seizures and cardiac toxicity. Bupivacaine has a high affinity for cardiac sodium channels and can cause brady-dysrhythmias as well as ventricular tachycardia and ventricular fibrillation in humans.

Conclusions

Effective local blocks are not a replacement for safe, effective general anesthesia or multimodal postoperative pain management. Use of local anesthetic agents helps to reduce the amount of inhalant general anesthesia required to keep a veterinary patient sleeping. The unwanted, most frequently seen complications associated with general anesthesia in veterinary patients who are anesthetized for any reason are hypotension, cardiac dysrhythmias, hypercapnea and hypoxemia. Multimodal analgesia anesthesia can help reduce these unwanted side effects by reducing the amount of gas required to keep the patient anesthetized.

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