Regional Analgesia: Every Nerve Block Needed for Dental Surgery

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Abstract

Due to the growing number of equine dental and sinus related procedures being performed there is great benefit for practitioners to utilize regional analgesia of the equine head. These nerve blocks in combination with a continuous rate infusion (CRI) of sedative(s) provide for a cooperative patient and when combined with anti-inflammatories also provide multimodal perioperative pain management. Today's practitioners most commonly have access to local anesthetics: lidocaine, mepivacaine and bupivacaine. With specific volumes and precise administration these anesthetics can be used to desensitize the mandibular and maxillary branches of the Trigeminal nerve to desensitize the dental quadrants. Regional nerve blocks to be discussed include: maxillary, mandibular (inferior alveolar), mental, infraorbital, supraorbital and the infratrochlear nerve. The use of these blocks requires thorough knowledge of each approach (extra-oral and intra-oral) along with anatomical landmarks, pitfalls and complications.

Keywords; Nerve block, analgesia, oral surgery, dental block, pain management

Introduction

A growing number of dental and sinus related procedures are being performed on well-sedated standing equine patients. Safety for the horse and clinician are required for any procedure to be a success. Injectable sedation or the use of a constant rate infusion (CRI) of sedative(s) alone is not suitable to provide appropriate patient analgesia. A properly

placed regional nerve block facilitates analgesia for the patient. Regional analgesia when combined with a closely monitored level of sedation provides a safe environment for both the patient and practitioner during standing dental procedures.

The approaches and information within this paper are a review of the published works of others and are referenced below.

Material and Methods

Local Anesthetic

Lidocaine, mepivacaine and bupivacaine each varies in lengths of onset / duration of action. Regardless of choice in anesthetic it should be injected slowly and at a volume appropriate for the site. These are described in further detail below.

Materials

- Clippers
- Sterile Gloves
- Chlorohexadine or Betadine scrub
- Spinal needles or Tuohy Epidural needles in 18-22 gauge, 3.5" and 6" lengths
- Hypodermic needles 21-25 gauge, 1" and 1.5" lengths
- Syringes 3ml, 12ml, 20ml

Methods

Mental Nerve Block

This block provides desensitization of the rostral inferior alveolar nerve (mandibular nerve) after it traverses the mandibular canal and emerges as the mental nerve at the mental foramen. The mental foramen can be palpated externally on the lateral aspect of the mandible at the level of the commissures of the lips. The tendon of the depressor labii inferioris muscle should be digitally reflected dorsal to aid in palpation of the foramen. The mental foramen can also be palpated orally and located in the same fashion as described above, the muscle does not interfere with oral palpation of the foramen. This block is not well tolerated by the horse due to the likely

hood of coming into direct contact with the nerve. Tissues desensitized include the ipsilateral canine, incisors, rostral mandible, skin and lip.

- The injection site is clipped, cleaned and prepped.
- A 20-24 gauge, 1.5 inch needle and 5-10ml of local anesthetic agent is prepared.
- Palpate the foramen and place a needle into it at a 30-degree angle in a rostro-caudal direction. (The angle is less severe with the intraoral approach)
- Inject 5-10ml slowly into the foramen while holding a finger with slight pressure over the foramen to prevent backflow / escaping of the anesthetic agent from the canal.
- Placing a slight bend into the needle prior to insertion into the foramen may be helpful

Mandibular Nerve Block (Inferior Alveolar nerve)

This block provides desensitization of the ipsilateral mandible including cheek teeth, canine, incisors and lip. The inferior alveolar nerve is blocked as it branches away from the mandibular nerve and travels through the mandibular foramen into the mandibular canal. The mandibular foramen is located rostrally in the medial aspect of the coronoid process, at the level of the occlusal surface. This foramen can be located at the intersection of a line along the occlusal surface of the maxillary cheek teeth and a perpendicular line through the lateral canthus of the eye. A colored pen can be used to mark the point of intersection. The extra-oral injection site is ventral to this point and is directed on the medial aspect of the mandible in a dorso-lateral direction. If the needle is advanced rostral to the foramen where the inferior alveolar nerve enters the mandibular canal then the nerve will not be desensitized by the anesthetic agent. With this in mind it is advisable to conservatively aim slightly caudal to the mandibular foramen while advancing the spinal needle. The intra-oral injection site is located caudal to the third molar along the medial aspect of the ramus.

<u>Extra-oral approach</u>

- The injection site is clipped, cleaned and prepped.
- A 18-22 gauge 6” Spinal or Tuohy epidural needle and 10-20ml of anesthetic agent is prepared.
- The needle is inserted ventral to the mark of the intersecting lines discussed above and slowly advanced to the depth of the mandibular foramen while maintaining close proximity to the vertical ramus of the mandible.
- A second needle can be used laterally to judge the depth necessary to reach the foramen.

- Once the depth has been reached 12-20ml of anesthetic agent is slowly injected.

Intra-oral approach

- Specialized instrumentation, long handled forceps, are required to effectively reach this caudal aspect of the mouth for both prepping the site and for injection.
- A 18-22 gauge 1.5" butterfly catheter with a 90-degree needle and a long extension set will aid in the delivery of the anesthetic to the caudal recess of the oral cavity.
- A dental mirror will aid in depressing the tongue and aid in viewing the injection site.
- Oral endoscopy if available is also helpful.
- A smaller amount of anesthetic is delivered, 3-5ml.

Infraorbital Nerve Block

This block provides desensitization of the ipsilateral canine, incisors, lip and face up to the level of the infraorbital foramen. Anesthetic agent that travels and fills the canal caudally from this site may also desensitize the ipsilateral cheek teeth. The location of the infraorbital foramen is dorsal and rostral to the facial crest. Using a 3-finger technique, in which a thumb is placed on the rostral aspect of the facial crest, middle finger is placed in the notch formed by the nasal bone and premaxilla, and the index finger is placed equidistant between the two of them. The levator labii superioris muscle crosses the infraorbital foramen and must be elevated by the index finger prior to palpating the foramen.

- The injection site is clipped, cleaned and prepped.
- A 19-22 gauge, 1.5" needle or 3.5" Tuohy needle and 5-10ml of anesthetic agent is prepared.
- The foramen in located as described above and the needle advanced into the skin beginning 1 cm rostral to the foramen.
- The needle is advanced to a minimum depth in an attempt to avoid damage to the neurovascular bundle within the canal.
- 5-10ml of anesthetic agent is injected slowly.

Heavy sedation and restraint are advised as most horse do not tolerate this block well.

The needle inevitably will contact the infraorbital nerve within the canal, causing head tossing or rearing.

Supraorbital Nerve Block

This block provides desensitization of the forehead and middle two thirds of the upper eyelid. The supraorbital nerve is of particular importance in sinus surgery involving a frontonasal flap. The nerve is a branch of the ophthalmic nerve off the trigeminal and is located at the level of the supraorbital foramen. The foramen is easily palpated 1cm caudal to the upper orbital rim or 5-7cm dorsal to the medial canthus of the eye.

- The injection site is clipped, cleaned and prepped.
- A 23-25 gauge, 1" needle and 3ml of anesthetic agent is prepared.
- The foramen is located and 1ml of anesthetic is deposited superficially.
- The needle is advanced to the full depth and 2ml of anesthetic is injected into the site, slowly.
- Needle is removed and digital pressure applied briefly.

Infratrochlear Nerve Block

This block desensitizes the medial canthus along with the skin rostral and ventral extending along the facial crest to near the infraorbital foramen. The infratrochlear nerve is a branch of the ophthalmic nerve off the trigeminal nerve. It is located by palpating the notch on the dorsal rim of the orbit near the medial canthus of the eye. This block is of importance for sinus surgery involving a frontonasal or maxillary flap.

- The injection site is clipped, cleaned and prepped.
- A 25 gauge, 1" needle and 3ml of local anesthetic is prepared.
- The needle is inserted at a 30-degree angle dorsally towards the notch.
- At the level of the notch 1-3ml of anesthetic agent is deposited slowly.
- Needle is removed and digital pressure applied briefly.

Maxillary Nerve Block (Infraorbital Nerve)

This block provides desensitization of the ipsilateral dental structures of the maxilla, premaxilla, paranasal sinuses and nasal cavity. The maxillary nerve is a branch from the trigeminal nerve and emerges from the foramen rotundum crossing the pterygopalatine fossa and enters the maxillary foramen as the infraorbital nerve. The nerve can be blocked as it exits the foramen rotundum by a dorsal approach just distal to the zygomatic process of the frontal bone. The nerve can also be accessed along the pterygopalatine fossa from lateral and caudolateral approaches, both of which are ventral to the zygomatic process.

- The injection site is clipped, cleaned and prepped.
- A 18-20 gauge, 3.5" Spinal or Tuohy needle and 10-20ml anesthetic agent is prepared for the dorsal and lateral approaches.
- A 18-20 gauge, 6" Spinal or Tuohy needle and 10-20 ml anesthetic agent is prepared for the caudolateral approach.

Lateral Approach

- The needle is inserted ventral to the facial crest at the narrowest point of the zygomatic arch, perpendicular to the lateral canthus of the eye. Needle is advanced horizontal until it comes in contact with bone. Anesthetic agent is slowly injected.

Lateral Approach EFBI (Extraperiorbital fat body insertion)

- Same approach as above with the exception of contacting the bone. The needle is inserted until the distinct transition from masseter muscle to periorbital fat is "felt" as resistance of passing the needle. The medial fascial plane of the masseter muscle can be felt as a distinct "pop" as the needle advances through it into the fat body. The needle is then advanced 1.5 cm to place it directly in the fat body and anesthetic agent is slowly injected.
- Ultrasound guidance will also confirm proper needle placement and subsequent anesthetic injection

Caudolateral Approach

- A 6" needle is inserted ventral to the most caudal / dorsal aspect of the zygomatic process. The needle is then advanced rostrally and ventrally aiming for the contralateral facial crest, until the needle contacts bone, slowly inject the anesthetic agent.

Dorsal Approach

- The needle is inserted through the skin distal and dorsal to the zygomatic process of the frontal bone, where it attaches to the zygomatic bone and there is a right angle formed by the zygomatic arch. The needle is directed downward at a 20-degree angle from horizontal and advanced until it contacts the dorsal aspect of the orbital part of the frontal bone. The needle is then incrementally stepped ventrally to an approximation of the dorsal aspect of the foramen rotundum. Injection dorsal to this location allows anesthetic to diffuse ventrally to the desired location.

Discussion

Local anesthetic drugs each work through the same mechanism of action, which is to block the nerve impulse. This is achieved by blocking the flow of sodium ions through the cell membrane. The flow of sodium ions across the cell membrane is necessary to depolarize a neuron, leading to an action potential or nerve impulse. Local anesthetics approved for use in the horse include lidocaine, mepivacaine and bupivacaine. These each consists of a lipophilic group connected to a hydrophilic group by an intermediate chain (amide). The lipophilic

group provides the lipid solubility needed to pass through the cell membrane. Potency of the anesthetic increases as the lipid solubility of the molecule increases, this is important in choosing which agents to use. Presences of infection and necrotic tissue form an acidotic environment that reduces the potency of anesthetics. The amide anesthetics are metabolized by the liver and may be of concern in patients with liver disease. These products differ in lipid solubility and therefore in potency. Bupivacaine provides a longer duration of action but also has a longer onset of action. Lidocaine and mepivacaine have a shorter duration of action but faster onsets. When choosing an anesthetic agent thought should be given not only to the time needed to perform a given surgical procedure but also to providing adequate patient analgesia post-operatively.

The administration of the regional nerve block should be done prior to the dental or maxillofacial surgery to allow for adequate patient analgesia. The use of CRI (constant rate infusions) sedative agents in conjunction of a well-placed regional nerve block allows many dental and sinus surgical procedures to be performed in a standing and cooperative horse. Nonetheless, there are times that procedures are better performed under general anesthesia due to technical difficulty, patient cooperation or the nature of the surgery (i.e. fracture repair). Regional analgesia is important for procedures performed under general anesthesia and should be a part of the pain management plan in these cases as well.

There are complications and side effects that are encountered as a result of regional nerve blocks performed in the equine skull. Neurovascular damage is a major complication that can occur as needles are introduced into small boney canals or areas with large vessels. This damage can lead to hematomas, which may apply pressure to adjacent structures causing additional complication. Needle selection and placement is crucial to minimizing the damage to unintended structures. The Tuohy needle has a rounded bevel with cutting edges to the side. The bluntness of this needle creates more drag and increases tactile feedback. Use of this needle helps in the placement of the maxillary nerve block (EFBI Technique) as there is a change in tissue impedance as the needle passes through muscle into the fat body. Other complications associated with regional nerve blocks are often due to unwanted desensitization of adjacent tissue or nerves. These may include Horner's Syndrome, blindness,

pupil dilation and orbital protrusion from anesthesia of the optic nerve and relaxation of the oculomotor nerves during a maxillary nerve block. These can be avoided by choosing an approach that minimizes the likelihood of desensitizing unwanted structures and by avoiding the use of large volumes of anesthetic. The author prefers to approach the maxillary nerve with a lateral approach using the EFBI Technique as described by Staszyk et al. with a volume of 10ml anesthetic agent. Additional complications encountered may include local cellulitis, temporary lip paralysis or neuropraxia. The risk of complications following regional nerve blocks can be minimalized by using proper aseptic tissue preparation, adequate restraint / sedation, and by using accurate needle placement.

In summary proper and careful administration of both the maxillary (EFBI) and the mandibular (inferior alveolar) nerve blocks allow for desensitization of all dental structures and are useful in dental procedures. Supraorbital and infratrochlear blocks aid in paranasal sinus surgery and well tolerated in the horse.

References

Bardell D, Iff I, Mosing M. A cadaver study comparing two approaches to perform a maxillary nerve block in the horse. Equine Vet J 2010; 42:721-25.

Doherty T, Schumacher J. Dental restraint and anesthesia. In: Easley J. Dixon P, Schumacher J ed. Equine dentistry 3rd ed. London: Saunders Elsevier, 2011: 241-244.

Harding PG, Smith RL, Barakzai SZ. Comparison of two approaches to performing an inferior alveolar nerve block in the horse. Equine Vet J 2010; 42:721-725.

Henry T, Pusterla N. et al. Evaluation and clinical use of an intraoral inferior alveolar nerve block in the horse. Equine veterinary journal 2014; 6: 706-710.

Klugh DO. Regional and local anesthesia. In: Klugh, DO ed. Principles of equine dentistry. London: Manson, 2010: 120-128.

Rawlinson JE. Addressing pain: regional nerve blocks, in proceedings. AAEP Focus on Dentistry September 18-20, 2011; 74-81.

Simhofer H. Local anesthesia for dental procedures, in proceedings. AAEP Focus on Dentistry August 4-6, 2013; 59-60.

Staszyk C, Bienert A, Gasse H, et al. Stimulation of local anaesthetic nerve block of the infraorbital nerve within the pterygopalatine fossa: Anatomical landmarks defined by computed tomography. Res Vet Sci 2008;85(3):399-406.

Tanner RB, Hubbell JAE. A retrospective study of the incidence and management of complications associated with regional nerve blocks in equine dental patients. J. Vet. Dent. 2019; 36 (1): 40-45.

Tremaine, WH. Local analgesic technique for the equine head. Equine vet. Educ 2007; 19 (9) 495-503.

Conflict of Interest:

The author discloses no conflicts of interest.

Care and Use of Animals:

The manuscript does not report experimental data and therefore no approval was needed by Animal Care and Use Committee