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Essentials of Anaesthesia

Mini Series

Session Two: Local Anaesthesia in Small Animals

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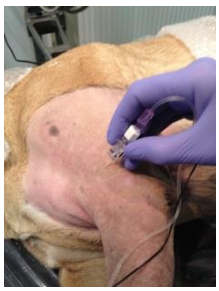

Mini Online Series "Essentials of Anaesthesia"
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Session 2

Local anaesthesia

What is local anaesthesia?

Local anaesthesia is the technique of performing nerve blocks using local anaesthetic drugs, most commonly alone but also in combination with other drugs to manipulate their onset, duration or add to their effect. The term loco-regional anaesthesia may be used to describe describing both local anaesthesia and neuraxial (epidural and spinal) anaesthesia. The objective of a local anaesthetic technique being to prevent or reduce perception of a painful stimulus (nociception).

Why perform local anaesthesia?

Local anaesthesia is used extensively in human medicine for the provision of intra and post-operative analgesia. The techniques utilised in veterinary medicine have largely been adapted from those described in human medicine but relevant species differences in regional anatomy are required for successful block performance. With clinical and cadaver studies now being carried out on a regular basis, it has allowed for a greater understanding of the most applicable techniques for our veterinary patients.

Local anaesthetic techniques are relatively easy to perform with a good knowledge of anatomy and require very little in terms of drugs and equipment. With careful practice they can form an important part of a patient's anaesthetic management. Perhaps most importantly local anaesthetic techniques are the only part of the anaesthetic protocol that completely blocks peripheral nociceptor input, thereby aiding in reducing the development of altered or chronic pain states.

Local anaesthesia can reduce intra-operative inhalational anaesthetic requirements, therefore reducing the adverse effects associated with this class of drugs, in particular vasodilation and subsequent hypotension. They can aid in providing a stable level of general anaesthesia and reduce the number of alterations that may be required to the vaporiser setting. They are therefore particularly useful in patients were avoidance of significant hypotension and reduced cardiac contractility are desired. This may be for example in patients with cardiac, renal or hepatic disease. By incorporating a local anaesthetic technique into a patient's protocol (alongside the use of opioids and non-steroidal anti-inflammatory drugs were appropriate) it allows for the provision of multi-modal analgesia, aids in improving post-operative analgesia and in reducing pain scores post anaesthesia.

Potential risks of local anaesthesia

There are a number of potential risks associated with the local anaesthetic techniques described but they are rare with appropriate training, the correct equipment and a good knowledge of species anatomy. Some of the risks that may be encountered include

- Inadvertent vascular injection
- Intra-neural injection
- Poor efficacy
- Poor technique
- Abnormal anatomy

Commonly used local anaesthetics

Local anaesthetics used in small animal practice include lidocaine, bupivacaine, levobupivacaine and ropivacaine. Bupivacaine and levobupivacaine are the most commonly used for the provision of loco-regional anaesthesia, primarily due to their longer duration of action compared to lidocaine. Levobupivacaine has superseded bupivacaine due to having a lower risk of cardiotoxicity, otherwise it is similar to bupivacaine. The clinical effect of a local anaesthetic depends on the dose, volume and route of administration. Careful calculation of the maximum dose to be used must be carried out as toxic levels are easily achieved, especially in smaller patients. For example, care should be taken when performing a local block in a cat following use of lidocaine topically prior to endotracheal intubation, as the two doses used are cumulative and both must therefore be considered.

Indicators of toxicity to be aware of include neurological signs such as seizures, which may be followed by cardiovascular signs such as rhythm and electrocardiogram (ECG) abnormalities. Under general anaesthesia neurological signs are not easily observed, therefore cardiovascular abnormalities are often the first sign of toxicity noted. Monitoring of the ECG is very important if any suspicion of toxicity is present. Diluting local anaesthetics helps to reduce local tissue toxicity, assist in avoiding excess drug administration and increase the volume potentially facilitating better absorption. On the other hand, though, over dilution should be avoided as it may reduce the clinical effect, with less local anaesthetic actually present in the required area.
Other drugs may be combined with local anaesthetics for the provision of locoregional anaesthesia, most commonly for epidural anaesthesia. The most commonly used adjunct with this technique being the opioid analgesics for example morphine or methadone.

Nerve Location
Electrical nerve locators are used to increase the accuracy and safety of local anaesthetic techniques. This relies on the nerve being stimulated having a motor component – stimulation of the nerve produces a response in the corresponding muscle. An electrical nerve locator (ENL) will stimulate muscular twitching at a close distance to the nerve without actually touching it; hence, providing greater accuracy for local anaesthetic deposition. Needles have an insulated shaft so the current comes from the tip. The needle is connected to the current meter and a syringe.

The further the needle is from the nerve the greater the current required to stimulate (Coulomb's Law). However, if the needle is in the nerve, a twitch may not be seen – only when the needle is moved away does a twitch appear. The aim is to get the needle as close as possible to the nerve without actually touching the nerve.
The ENL is essentially a current generator – the output can be varied. For most blocks start at a current of 1mA. Once the nerve is located step down to 0.2mA in increments of 0.2mA– at this current no stimulation should occur. If stimulation does occur at 0.2mA the needle is too close to the nerve sheath and at this point injection could cause nerve damage.

Once you are at a current of 0.2mA with no stimulus, go back up to 0.4mA at which point you should see the twitch resume. Aspirate & start the injection –the stimulation will cease – this is not the local working but the nerve being separated from the stimulating needle by the fluid injected – this is known as the Raj test.

Practical Tips
Move the needle forwards and backwards and not laterally. This may push the needle towards the nerve, but there may still be tissue in between the needle and the nerve.
Investigate the area in an arc when searching for the nerve.
Aspirate before every injection.

Ultrasound-guided nerve location
Ultrasound in regional anaesthesia offers a new standard in nerve location and identification, allowing real-time imaging of nerves and direct needle guidance.
All needles show up equally well on ultrasound, but it is imperative that the needle tip is in the field of vision at all times.
The aim is not to touch the nerve but place the needle close to it; nerve identification can be confirmed by the combined use of peripheral nerve stimulation.
A successful block is one in which the local anaesthetic is seen to spread around the nerve under direct vision – referred to as the donut sign.
Ultrasound location offers the opportunity to improve success, reduce complications, and enhance teaching of regional anaesthesia.
There are now a growing number of US guided approaches described in both dogs and cats and this method is rapidly becoming best practice.

Techniques

Head blocks

There are four commonly performed 'head' blocks. The **mandibular** nerve is located on the medial aspect of the vertical ramus of the mandible and may be blocked either from an intra-oral approach or through the skin on the ventral aspect of the mandible. To perform this block the mandibular foramen should be located digitally within the oral cavity and used to direct the needle for correct placement of local anaesthetic. This block allows desensitization of the entire mandible on the ipsilateral side and is suitable for dental, gingival and mandibular surgery. It is not advised to perform a bilateral block due to the potential for self-trauma to the tongue.

The **inferior alveolar (mental)** nerve is located on the lateral aspect of the rostral mandible and may be blocked where it exits from the mental foramen, which is easily palpable between the lower canine and first premolar. The needle may be advanced with care into the mental foramen prior to injection. The gingival fold often lies over this region and may make needle placement difficult. This block will only desensitise the most rostral aspect of the mandible and in most cases up to two thirds of the associated canine. It may be blocked bilaterally for rostral dental procedures.

The **infra-orbital** nerve is located where it exits from the infra-orbital canal on the lateral aspect of the maxilla. The block may be approached through the skin or the gingiva, aiming for the infra-orbital canal, which may be palpated, at a line drawn ventrally from the medial canthus of the orbit. The block may be performed using a hypodermic needle to deposit local anaesthetic at the entrance of the infra-orbital canal or by passage of a shielded over the needle type cannula to the level of lateral canthus prior to deposition of local anaesthetic. The traditional technique only allows desensitisation to the level of the mid maxilla whereas the modified approach has been described to be an acceptable alternative to the maxillary nerve block.

The **maxillary** nerve block is performed by palpating the caudal aspect of the zygomatic arch and identifying the most dorsal aspect, this will denote the needle entry point. The needle should be inserted in a cranio-ventral direction and a spinal needle may be required for sufficient needle length in well-muscled patients until the caudal aspect of the infra-orbital canal is located. Careful aspiration prior to local anaesthetic injection is required as it is possible to puncture the maxillary artery in this location. Use of this block is indicated for dental treatment and surgery to the upper dental arcade, soft palate and maxilla.

Palatine Nerve Blocks

Area desensitised- major palatine nerve runs with palatine artery to supply mucosa of the hard palate. It originates from the maxillary nerve in the pterygopalatine fossa. The major palatine nerve exits the major palatine foramen – unable to palpate because of thick palate.

Alternative – perform a maxillary nerve block

Indications – palate surgery. Teeth are not anaesthetised.

Volume to inject 0.1-0.3ml

Needle size – insulin syringe

Site for injection- halfway between the midline of the palate and the dental arcade at the level of the fourth premolar.

Ophthalmic blocks

The **retrobulbar** nerve block is approached dorso-lateral to the globe within the orbit, passing through either the skin or conjunctiva. It is only advised for use prior to enucleation due to risk of trauma to the globe and associated structures. A pre-curved or a self-curved needle should be walked off the orbital bone until the tip of the needle is caudal to the globe. Care should be taken to aspirate prior to injection and if excess pressure is encountered during local anaesthetic injection, the needle should be repositioned and the injection repeated.

Peribulbar technique

This is an alternative technique to retrobulbar block. A short needle (23G 1") needle is passed through the bulbar conjunctiva (avoiding the 12, 3, 6 and 9 O'Clock positions) along the bony orbit, but unlike the retrobulbar technique is not curved to end caudal to the globe. Local anaesthetic solution (2-4ml) is injected after aspiration. Gentle massage of the globe should be performed following this technique to encourage spread of local anaesthetic into the intraconal space. This technique requires a larger volume than retrobulbar block to ensure sufficient spread, but avoids the risk of penetrating the optic nerve sheath.

Sub-Tenon capsule block
Desensitised area as for retrobulbar block but improved safety on retrobulbar technique (Ahn et al. 2013, Shilo-Benjamini et al. 2013). Utilising this technique produces good desensitisation for enucleation or for corneal surgery. Skin sensation may not be completely eliminated though and additional analgesia may be required for skin closure. This technique requires additional equipment and is technically more challenging than the retrobulbar technique.
The patient should be positioned in dorsal recumbency and a sterile prep performed. After application of topical anaesthesia the mediodorsal portion of the bulbar conjunctiva (approx 5 mm from the limbus) is incised with tenotomy scissors, and the conjunctiva and sub-Tenon capsule are bluntly dissected from the underlying sclera. Sub-Tenon injection is performed through the incision with a 19-gauge, curved, blunt spatulated cannula. The sub-tenon cannula often requires gentle tissue dissection as it is passed to allow it to be positioned caudal to the globe.
Volume 1-5mL

Peri-ocular blocks
Used for desensitising the skin around the eyes. Useful for mass removal, eyelid surgery or as part of enucleation.

- Infiltrative blocks
- Provides analgesia (V)
- Immobilise eyelids (VII) & balance anaesthesia
- infratrochlear
- zygomaticotemporal
- frontal
- lacrimal

Ear Surgery
Techniques for blocking the auriculotemporal and greater auricular nerves are described in dogs. These nerves provide sensory innervation to the inner surface of the auricular cartilage and the external ear canal.
Surgeons may be concerned that they may cause facial nerve damage with this surgery and your local block may mimic this until the local wears off.
The use of wound catheters has been described in two separate studies post TECA. When compared to systemic morphine the dogs in which lidocaine wound soakers were used compared favourably.
Volume 0.5ml/10kg split over the two sites.

Thoracic limb blocks
The **brachial plexus** (BP) may be blocked by the axillary approach prior to any planned surgery to the forelimb although it may be less effective for surgery proximal to the elbow. The BP block may be performed blind or with the aid of ENL or US guidance. Care should be taken during this technique to avoid creating a pneumothorax and it should only be performed unilaterally due to potential for blocking of the phrenic nerve. The BP nerves arise from the spinal nerve roots of C6, C7, C8 and T1 and a successful technique will block the musculocutaneous, radial, ulnar and median nerves. The patient is positioned in lateral recumbency with the affected limb uppermost. A spinal needle is introduced parallel to the thoracic wall, cranial to the acromion and medial to the subscapularis muscle at the level of the scapulohumeral joint and directed in a caudo-dorsal direction. The first rib should be located, which will mark the caudal aspect of the brachial plexus. Local anaesthetic should be deposited as the needle is advanced, aspirating prior to each injection. Electrical nerve location may be used to identify each nerve individually prior to local anaesthetic injection.

A number of methods for blocking the nerves that form the brachial plexus are described, such as the cervical paravertebral approach and subscalenic approach. The technique chosen will depend on the surgical site.

Hindlimb techniques
These techniques will be discussed in more detail during the session and the approaches outlined for use with ENL. Use of US guidance is also described in the literature to approach both nerves.

Sciatic nerve
With the parasacral approach the ScN is blocked at its origin from L7, S1 and S2. A line drawn from the cranial dorsal iliac crest to the ischiatic tuberosity is divided into thirds with the injection site at the junction of the cranial and middle third. The needle is advanced perpendicular to the skin under ENL guidance. A reported success rate of 60% is attributed to the volume of injectate used ($0.05ml^{-1}kg^{-1}$), therefore an increased volume is recommended but the ideal volume is yet to be determined.

Femoral nerve
The femoral nerve may be approached from the inguinal region, by blockade of the lumbar plexus at the level of L5 or the pre-iliac approach, whereby the nerve is blocked within the iliopsoas muscle.

Neuraxial blockade
Epidural and spinal anaesthesia both come under the banner of neuraxial blockade, whereby local anaesthetic, sometimes in combination with other drugs is deposited within the bony vertebral canal. **Epidural** (extradural) anaesthesia is most commonly employed in veterinary anaesthesia whereby the drug is deposited into the space outside of the dura. This technique is indicated for pelvic limb, perineal and abdominal surgery. Epidural injection is most commonly performed at the lumbosacral junction (L7-S1), although caudal injection may be performed at Co1-Co2. The caudal approach has increased in use, for several reasons, there is no risk of inadvertent spinal injection at the site and the drug volumes required have been shown to be the same as for the LS injection site.
For **epidural** anaesthesia the patient should be positioned in either sternal or lateral recumbency. In sternal recumbency the pelvic limbs should be extended cranially and the wings of the ilium palpated with the thumb and second finger. The dorsal spinous process of L7 is palpated in the midline with the index finger, the lumbosacral space lies caudal to this. The spinal needle is inserted in the midline perpendicular to the skin. The stylet is removed once in the subcutaneous tissue and saline applied to the needle hub. The needle is then advanced slowly until saline is aspirated into the needle due to the sub atmospheric pressure within the epidural space. The presence of cerebrospinal fluid (CSF) at this point should alert the clinician to withdraw the needle and re-confirm positioning within the epidural space. In the cat the more caudal extension of the spinal cord, makes it more likely that a spinal injection will be performed. Drug doses should be reduced by a half to three quarters if a spinal injection is performed instead. A test injection may be performed prior to aspiration and slow injection of the selected drugs. Preservative free drugs should be selected to minimise the risk of neurotoxicity.