

ADVANCED ANESTHETIC AND ANALGESIC TECHNIQUES
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Advanced pain management techniques such as local and regional blocks, analgesic constant rate infusions and epidural anesthesia/analgesia can be incorporated into almost any clinical setting. You do not need to work in a specialty referral hospital or academic institution to utilize and effectively perform advanced pain management techniques.

INTRODUCTION

Controlling pain in small animals, including exotic small mammals is extremely important. The use of epidural anesthesia/analgesia and constant rate infusions (CRIs) of analgesic drugs is an extremely effective way to manage pain. The species, type of procedure, and status of the patient must be taken into consideration prior to administration. An epidural should be considered for patients requiring painful procedures of the hind limbs, abdomen, thorax, and even the forelimbs.

EPIDURAL ANESTHESIA AND ANALGESIA

Epidural placement can be performed in as little as five minutes, therefore adding very little additional time to the total time under anesthesia. The patient is generally positioned in sternal recumbency although lateral recumbency is another option. The wings of the ilium should first be palpated. The lumbosacral space can be palpated between vertebral bodies L7 and S1. Prior to placing the epidural needle, the area should be shaved and aseptically prepared as you would for a surgical procedure. Sterile gloves must be worn when administering the epidural. A 25 or 22 gauge spinal needle is generally used with a length ranging from 1" to 3" depending on the size of the patient. The spinal needle should be placed on midline and slowly inserted through the skin and into the epidural space. A pop will be felt as the needle passes through the ligamentum flavum and enters the epidural space. If you hit bone, you have gone too far and need to back the needle out a little bit. A sterile glass syringe containing a small amount of air (1 to 2 mL) should be placed on the spinal needle and injected into the space. If the air injects easily then you are in the correct spot. If there is a vacuum on the syringe you are not in the correct space and you need to reposition.

You can also use a technique called the hanging drop technique. Once you have placed the spinal needle into the epidural space, you can place a drop of saline onto the opening of the spinal needle. If the drop is sucked into the hub of the spinal needle, you are in the correct space. If the drop of saline is not sucked into the spinal needle, you may or may not be in the correct spot. The hanging drop technique works much better in large animal species than small animals. Once you are in the correct space you can place the syringe with the drugs in it on the spinal needle. Aspirate back to ensure there is not any blood or spinal fluid. If blood is aspirated you need to pull out and start over. If spinal fluid is aspirated, you should only deliver about 1/4 of the initial calculated dose. Common drugs used for epidural administration include preservative free morphine, lidocaine, bupivacaine, and buprenorphine.

****Epidural anesthesia/analgesia should not be administered if the patient is septic or has signs of pyoderma or a skin infection around the epidural site.**

Common Drug Dosages

Preservative Free Morphine - 0.1 mg/kg diluted to 0.33 mL/kg with sterile saline, administered into the epidural space (with a maximum volume of 6.0 mL regardless of patient size)

Buprenorphine - 12.5 mcg/kg diluted to 0.33 mL/kg with sterile saline administered into the epidural space (with a maximum volume of 6.0 mL regardless of patient size)

Lidocaine – 0.5 mg/kg to 1.0 mg/kg diluted to 0.33 mL/kg with sterile saline administered into the epidural space (with a maximum volume of 6.0 mL regardless of patient size)

Bupivacaine – 0.5 mg to 1.0 mg/kg diluted to 0.33 mL/kg with sterile saline administered into the epidural (with a maximum volume of 6.0 mL regardless of patient size)

Preservative Free Morphine & Bupivacaine – 0.1 mg/kg of preservative free morphine mixed with 0.5 to 1.0 mg/kg bupivacaine (with a maximum volume 6 mL regardless of patient size)

Buprenorphine & Bupivacaine – 12.5 mcg/kg buprenorphine mixed with 0.5 to 1.0 mg/kg bupivacaine (with a maximum volume 6.0 mL regardless of patient size)

Example: You are going to administer a morphine and bupivacaine epidural to a 10 kg dog.

Calculation: (wt.) X (0.33mL/kg) = total volume therefore (10 kg) X (0.33mL/kg) = 3.3 mL total epidural volume

Preservative Free Morphine ((wt.) X (dose)) / (concentration of drug) = morphine dose in mL

Therefore ((10 kg) X (0.1 mg/kg)) / (25 mg/mL) = 0.04 mL

Bupivacaine ((10 kg) X (1 mg/kg)) / (5 mg/mL) = 2 mL

Now add the volume of morphine to the volume of bupivacaine. The total volume is 2.04 mL. We need to give a total volume of mL so the remaining volume of 1.26 mL will be added to the syringe of drugs. We will use preservative free saline for this remaining volume.

****It is important to note that the maximum dose of lidocaine and bupivacaine should not exceed 2 mg/kg and 1 mg/kg respectively. You must take into account any lidocaine and/or bupivacaine administered not only in the epidural, but also given in other local blocks such as ring blocks, line blocks, or even small amounts administered onto the tracheal opening to prevent laryngospasms (this is especially true for small exotic mammals and very small kittens, puppies, toy breeds, etc.).**

CONSTANT RATE INFUSIONS

Delivering a constant rate infusion(s) during general anesthesia is an excellent way to provide additional analgesia to the patient. Common drugs used for analgesic CRIs include ketamine, lidocaine, hydromorphone, and fentanyl. Using one or a combination of these drugs not only helps provide additional analgesia, but depending on the species, they may also help reduce the percentage of gas anesthesia (MAC) needed to keep the patient in a surgical plane of anesthesia. Reducing the amount of gas anesthesia has many benefits including helping reduce hypotension commonly experienced with inhalants such as isoflurane and sevoflurane. If fentanyl is used as a CRI the patient should be intubated and placed on intermittent positive pressure ventilation (either manual or mechanical) as this drug can cause severe respiratory depression.

In many instances, analgesic CRIs require a loading dose given at the onset of CRI delivery. A loading dose will quickly increase drug plasma concentration levels, enabling the low dose CRI to become effective quickly.

Common Dosages

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| Ketamine CRI | Loading Dose – 1 to 2 mg/kg | CRI - 10 to 20 mcg/kg/min |
| Fentanyl CRI | Loading Dose – 5 to 10 mcg/kg | CRI – 0.3 to 1.0mcg/kg/min (anes) CRI – 0.05 to 0.3 mcg/kg/min (post-op) |
| Hydromorphone | Loading Dose – 0.05 mg/kg | CRI – 0.05 to 1.0 mg/kg/hr (anes) CRI – 0.01 to 0.02 mg/kg/hr (post-op) |

(Cats are generally given a fentanyl loading dose of 5 mcg/kg and a CRI of 0.3 to 0.5 mcg/kg/min)

If you are inducing general anesthesia with ketamine or fentanyl, you can use your induction dose as your loading dose as long as you start your CRI within a few minutes of induction.

CALCULATING A CONSTANT RATE INFUSION

Calculating a CRI is very easy once you understand what formula to use. For example, let's say you are about to anesthetize a patient that requires a fracture repair of the right femur. How would you calculate a CRI of fentanyl?

The formula for calculating a CRI is as follows:

$$[(\text{Patient's weight}) \times (\text{Dosage of the drug}) \times (\text{*Time factor})] / \text{Concentration of the drug}$$

*The time factor for this equation is 60 minutes/hour

Let's say the patient weighs 2.0 kg and the dose of fentanyl that we are going to administer is 0.7 mcg/kg/min. Since my dose is given as mcg/kg/min, I will want to convert this to mL/hr. The concentration of fentanyl is 50 mcg/mL.

I now have all the information I need to calculate the CRI. How will I calculate this?

$$[(2.0 \text{ kg}) \times (0.7 \text{ mcg/kg/min}) \times (60 \text{ min/hr})] / 50 \text{ mcg/mL} = 1.68 \text{ mL/hr}$$

This standard equation can be used for other CRIs such as ketamine, hydromorphone, and dopamine or dobutamine, etc.

LOCAL ANESTHETIC TECHNIQUES

Local and regional anesthetic techniques are the only way to provide a complete blockade of peripheral nociceptive input, therefore they are the most effective way to prevent sensitization of the central nervous system and development of pathological pain. The onset and duration of local anesthetics will vary based on the drug chosen. However, the pre-operative use of local anesthetics will reduce inhalant anesthetic requirements and can often help patients have a smoother and less painful recovery. It is important to note that lidocaine has a quick onset, but a short duration of action while bupivacaine has a longer onset and longer duration of action. Lidocaine will become effective in little as 5 minutes and will last about 1 to 2+ hours. Bupivacaine will become effective in about 15 to 20 minutes and last about 4 to 6+ hours.

TOPICAL ANESTHETICS

Topical anesthetics such as 2.5% lidocaine and 2.5% prilocaine (EMLA cream) can be applied to skin for minor procedures such as intravenous and arterial catheter placement. It is advisable to shave the area of interest, spread on a thin layer of cream, and place an occlusive dressing over the area of application for at least 10 minutes. I especially like this technique for placing arterial catheters in the auricular artery of rabbit's ears.

SPLASH BLOCKS

Local anesthetics can be administered into existing wounds or open surgical sites. This is usually accomplished by either soaking gauze sponge with a local anesthetic or "splashing" the local anesthetic into the open wound.

INFILTRATION OF LOCAL ANESTHETICS

Local anesthetics are commonly used to provide additional anesthesia and analgesia for procedures such as minor laceration repair, skin biopsies, and removing small tumors lying just under the skin. Local anesthetics such as lidocaine and bupivacaine can be injected into the tissue, preferably around the nerve where you are trying to block pain sensation.

Infiltration of local anesthetics is generally quite easy and relatively quick. The area should be shaved and aseptically prepared prior to administering any drugs. Aseptic technique will help prevent accidental contamination of the tissues with skin bacteria when the local anesthetic is injected. Generally, a small 25 to 27-gauge needle attached to a 1 mL or 6 mL syringe is used to prevent tissue damage and allow for more precise administration of the drug. The volume of drug to be administered will vary based on the area of interest and size of patient. If the patient is very small and the volume to be delivered is tiny, it may be necessary to dilute the local anesthetic prior to administration. Sodium chloride 0.9% is the most common fluid used for dilution. Always remember to aspirate the syringe prior to giving the injection. If blood is aspirated, reposition and start over (this is true for any injection of a local anesthetic).

****Common local nerve blocks include dental, paravertebral, brachial plexus, intercostal, and distal limb blocks.**

Common dental nerve blocks include the maxillary, infraorbital, inferior alveolar, and mental blocks. Blocking these nerves provides excellent anesthesia for extractions and facial surgery. The maxillary nerve block provides anesthesia for the caudal portion of the maxilla. The infraorbital nerve block provides anesthesia for the rostral portion of the maxilla. The inferior alveolar nerve block provides anesthesia for the caudal portion of the mandible while the mental nerve block provides anesthesia to the rostral portion of the mandible. It is ideal to use an insulin syringe with attached needle for very small patients. A 1 to 3mL syringe with a 25 to 22-gauge needle attached can be used for larger dogs.

Blockade of the brachial plexus is generally used to manage peri-operative pain of the forelimb. The best technique for successfully blocking the brachial plexus is to block the nerves of the brachial plexus at C6 to T1. It is ideal to block the nerves as close to the intervertebral foramina rather than the axillary space. It is important to note that this procedure is not benign. The phrenic nerve can become blocked, anesthetizing a portion of the diaphragm, thus a brachial plexus block should only be performed unilaterally. Other complications include pneumothorax, intravenous, and intrathecal injection. A nerve stimulator and insulated needle should be used to increase the success rate of this block.

Intercostal nerve blocks can be used for patients with fractured ribs or for those undergoing a lateral thoracotomy. To provide complete blockade of the affected area, the local anesthetic should be injected not only at the caudal border of the rib at the fracture or incision site, but also two to three ribs on either side of the fracture or incision site.

Distal limb blocks are effective for procedures involving the lower extremity and digits. Examples include dew claw removal, cat declaws, mass removals, etc. A small amount of local anesthetic is injected around the nerve subcutaneously and caudal to the surgical site. Common sites include the radial, ulnar, and median nerves.

SUGGESTED READING

Bryant, Susan. 2010. *Anesthesia for Veterinary Technicians*. Wiley and Sons.

Seymour, Chris and Tanya Duke-Novakowski. 2007. *BSAVA Manual of Canine and Feline Anaesthesia and Analgesia*. 2nd ed. British Small Animal Veterinary Association.

****All drugs listed in these proceedings are common dose ranges used in the Small Animal Anesthesia Department at the UC Davis VMTH. Doses should be approved by the veterinarian prior to administration.**