Local Analgesic and Anesthetic Blocks
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Local anesthetics are the only analgesic drugs which completely block transmission of nociceptive impulses transmitted from the periphery to the central nervous system. They are also very effective when given systemically to help treat inflammatory or neuropathic pain and may have neuroprotective properties. Local anesthetics are also comparatively inexpensive. These characteristics provide a great opportunity to incorporate these drugs and techniques into a balanced, multimodal approach to peri-operative pain management.

Mechanism of action
Local anesthetics exert their effect by binding to the sodium channel, thereby preventing sodium influx and depolarization of nerves. They also provide anti-inflammatory effects by reducing production of eicosanoids, thromboxane, leukotriene, histamine and inflammatory cytokines and the scavenging of oxygen free radicals.

Toxicity
Overdose of local anesthetics or inadvertent intra-venous administration can be fatal. Observation of reported dose rates, including species differences, careful calculation and aspiration to check for vessel penetration are important strategies to avoid complications. Central nervous system symptoms of toxicity (tremors, excitation, muscle twitching, seizures, coma) usually occur before cardiovascular signs but early neurologic signs of toxicity can be masked by sedation and general anesthesia. Cardiovascular signs include: tachycardia, arrhythmias, direct myocardial depression, hypotension, bradycardia, cardiovascular collapse, cardiac arrest refractory to resuscitation and death.

Toxic doses of specific drugs:
- Lidocaine => Dogs 10mg/kg, Cats 5mg/kg, should NOT be given IV in cats
- Bupivacaine => Dogs 4mg/kg, Cats 2mg/kg, should NEVER be given IV
- Ropivacaine => 4.5mg/kg IV in dogs

Bupivacaine is the most toxic of the local anesthetics: the toxic dose is lower, arrhythmia and cardiovascular collapse can be seen at the same time or before early warning signs of toxicity, mortality rates are higher with overdose.

Intra-articular administration of local anesthetics: Recently, the FDA has issued a warning against the intra-articular administration of local anesthetic since studies have indicated that bupivacaine can cause chondronecrosis in vitro/vivo in human, and in vitro in bovine, equine and canine chondrocytes. In vitro studies indicate an adverse effect of bupivacaine on canine chondrocytes but in vivo effects of a single dose remains unknown. However, there is sufficient evidence regarding the chondrotoxic effects of local anesthetics on cartilage to discourage the use of intra-articular local anesthetic.

Prolonging the effect
Mixtures of two local anesthetic drugs in an effort to maximize the preferred characteristics of each individual drug. For example, lidocaine is mixed with bupivacaine in order to take advantage of the fast onset of lidocaine but have the longer duration of action of bupivacaine. There is little data regarding the safety, efficacy or pharmacokinetics of mixing different local anesthetics. A recent study in sheep evaluating lidocaine and bupivacaine alone and then in combination indicated that the onset of blockade was not significantly faster but the duration of action of the combination was decreased. The lack of evidence regarding mixtures of local anesthetics suggests that a better approach may be to select a single agent best suited for the patient and procedure.

Dexmedetomidine added to local anesthetic has been shown to significantly prolong peripheral and epidural local anesthetic action in humans and rats. Dexmedetomidine enhances local anesthetic action via the alpha-2A receptor and by blocking the hyperpolarization-activated cation current. To date, there have not been any published studies in dogs, however, a dose of 1 – 2 mcg/kg added to the local anesthetic dose has been suggested. Monitoring of heart rate, ECG, blood pressure and SpO2, along with oxygen supplementation is recommended as systemic effects of dexmedetomidine can be observed.

Intravenous lidocaine
Lidocaine (2mg/kg) given IV over 2 minutes prior to induction can serve as a ‘loading dose’ for an intravenous lidocaine constant rate infusion. The CRI dose is 25-50ug/kg/min. Lidocaine CRI is effective for systemic analgesia, anti-inflammatory and/or neuroprotective effects, enhanced GI motility and inhalant sparing effects. In humans, it has been shown to decrease post-operative pain and opioid use, resulting in quicker return of normal bowel function and quicker hospital discharge. Lidocaine CRI is routinely used in equine small intestinal disease; its anti-inflammatory effects help alleviate visceral pain and result in increased motility.
Intravenous lidocaine, especially when combined with morphine and ketamine, greatly reduces the inhalant anesthetic requirement by up to 40%; many of our clinic patients have major orthopedic surgery on 1% or less Isoflurane using MLK intra-operatively. Careful monitoring of anesthetic depth and titrating inhalant to lowest level required is necessary to avoid ‘overly deep’ and respiratory depressed patients. Monitoring of EtCO₂ and the ability to institute IPPV aids with patient management.

- Add to 500ml bag of crystalloid fluids: Lidocaine (20mg/ml) 15 mls (300mg)
- Infuse @ 5mls/kg/hour for the first hour then reduce to 2.5mls/kg/hr *
- This will provide a dose of 50mcg/kg/min for the first hour and 25mcg/kg/min for the second hour

Transdermal/IV catheter
IV catheter placement in awake patients – mix 1 part sodium bicarbonate with 9 parts lidocaine (ex. 18 units lidocaine, 2 units bicarb in insulin syringe) immediately prior to use.

Lidocaine patches – Commercial 5% lidocaine patches (Lidoderm®) can provide post-operative incisional pain. Pharmacokinetic studies in dogs and cats indicate there is minimal systemic absorption however, there have not been studies evaluating the effectiveness of analgesia with their use.

Abdominal incisional/cavity blocks
Incisional infiltration of local anesthetic can be administered prior to surgical incision or once the linea closure is complete. Local anesthetics can also be applied as a ‘splash block’ after linea closure.

Results of human and veterinary studies indicate that incisional and intra-peritoneal local anesthetics can decrease post-operative opioid requirements and improve pain scores. With proper technique and avoidance of needle induced trauma, local anesthetics can be used without impairing wound healing or increasing incisional complications.

Studies on the effect of local anesthetics on wound healing indicate that, owning to their anti-inflammatory effects, local anesthetics may have inhibitory effects on the first two stages of wound healing (inflammatory and granulation/proliferation stages). However, the clinically important end point (that of wound strength), was not affected by tissue infiltration of local anesthetics.

Epidural
The advantages of using epidural analgesia include the delivery of analgesic drugs in close proximity to their site of action resulting in more profound analgesia and the ability to lower the drug dosage resulting in less systemic side effects. If performed pre-operatively, epidural analgesia provides pre-emptive analgesia and is an adjunct to general anesthesia resulting in decreased inhalant anesthetic requirements and therefore less cardiovascular depression. Epidural analgesia can provide longer lasting post-operative analgesia, making it particularly adaptable to private practice.

Contra-indications to performing epidural administration of analgesics are: coagulopathy, since hemorrhage in the epidural space may cause compression and pain, general or localized sepsis risks introduction of infection into the central nervous system. Trauma may also be a contraindication if there is significant bruising or tissue damage over the site of injection.

Equipment needed includes: spinal needles of varying lengths (1.5 – 3.5 inches), 20 gauge for most medium to large sized dogs and 22 gauge for small dogs and cats.

Miscellaneous items include: Sterile gloves, materials to clip the hair and perform a surgical prep, syringes and needles. Optional but recommended: Loss of resistance syringe

Positioning
Patients may be positioned in either sternal or lateral recumbency. Sternal recumbency has several advantages as it is easier for the operator to keep the spinal needle in the correct planes with respect to cranial/caudal and side to side orientation. It also allows use of the ‘hanging drop’ method for confirmation of correct needle placement. The hindlimbs may be positioned in one of two ways while the patient is in sternal recumbency:

1. ‘Frog legged’ with the hind limbs resting on the stifle and the feet extended posteriorly – this position may allow easier palpation of anatomical landmarks in obese patients.
2. Rostral extension of the hindlimbs – A recent computed tomography (CT) study indicated that rostral extension of the hind limbs significantly increases LS and L6-L7 distance and LS angle and may enhance the ease of lumbosacral epidural injection in sternaly recumbent anesthetized dogs.

Patients may be positioned in lateral recumbency in cases not amenable to sternal positioning such as femoral fracture or severe, multiple pelvic fractures. The hindlimbs are taped or held in a rostral position by an assistant and a loss of resistance syringe is recommended to confirm proper placement.

Anatomic landmarks
The thumb and third fingers of the operator’s non-dominant hand are used to palpate the cranial border of the iliac crests. The index finger is placed on the patient’s midline and palpates the lumbosacral space as a depression on the midline. The index finger is also
used to confirm proper space by palpating cranially (the dorsal spinous process of L6 is larger than L7) and caudally (the sacrum does not have intervertebral spaces)

**Preparation**
The injection site should be clipped of hair and receive a surgical preparation to avoid infection/abcess of the epidural space or discospondylitis.

**Technique**
The spinal needle is inserted on the midline, caudal to L7 approximately in the middle of the LS space. The needle is position perpendicular to the pelvis with the bevel of the needle directed cranially. The needle will traverse through the skin, subcutaneous tissue and interspinous ligament and the stylet is removed. If the ‘hanging drop’ technique is being used, the hub of the needle is filled with the drug to be administered. As the needle is then advanced, a ‘popping’ sensation may be felt as the needle penetrates the ligamentum flavum (interarcuate ligament). The tail may twitch if the needle comes in contact with the cauda equine. If the operator feels they are ‘hitting bone’, reassess the angle of the needle placement and adjust to increase or decrease the angle for proper placement. If the angle seems correct, the needle may be embedded in the ventral aspect of the vertebral canal. In this instance, careful, slight retraction of the needle may allow the ‘hanging drop’ to be drawn into the space.

**Confirmation of proper needle placement**
There are two methods to confirm proper epidural placement of the spinal needle: The ‘hanging drop’ technique and loss of resistance. The ‘hanging drop’ technique can only be used when the patient is positioned in sternal recumbency. The hub of the spinal needle is filled with saline or the drug to be delivered before penetration of the ligamentum flavum. Once the ligament is penetrated, the solution is drawn into epidural space due to negative pressure. The ‘loss of resistance’ technique may be used when the patient is positioned in either sternal or lateral recumbency. This technique requires the use of a special loss of resistance syringe (cost ~$1.00 – 2.00 each, single use). Once the spinal needle is placed in the epidural space, 1 – 3 mls of air or saline can be injected, lack of resistance on the plunger confirms proper placement.

**Injection**
Prior to injection, the hub of the spinal needle should be observed for the presence of cerebral spinal fluid (CSF) or blood. If blood is observed, the spinal needle should be withdrawn and the epidural can be attempted again with a new spinal needle. DO NOT inject drugs intended for epidural administration if blood is observed as inadvertent IV injection of local anesthetics is the most common cause of systemic toxicity (convulsions, cardiovascular depression). Bupivacaine, which is a commonly used local anesthetic for epidural administration in veterinary medicine may cause ‘non-resuscitatable cardiac arrest’ due to its increased cardiotoxicity. Therefore, it is recommended to **Always aspirate before injection***

CSF may be observed in the hub of the spinal needle after placement. This indicates that a subarachnoid puncture has occurred and that ‘spinal’ anesthesia/analgesia rather than epidural will be achieved with drug injection. Subarachnoid administration will result in more cranial migration of drugs and more rapid onset of anesthesia/analgesia and therefore, the calculated dose should be reduced to ¼ to ½ of that intended for epidural administration.

**Species/size differences**
There are species and size/age differences with respect to where the spinal cord ends. This is an important consideration as it is more likely to enter the subarachnoid space the more caudally the spinal cord ends. The spinal cord typically ends at L7 in medium/large adult dogs, however, in cats and in small or young dogs, the spinal cord and meninges may extend to LS space.

**Drugs**
The most commonly drugs used for epidural administration are opioids and local anesthetics or the combination of the two drugs. Other drugs that have been investigated include: alpha-2-agonists, ketamine, opioid agonist/antagonists, NSAIDs, neurokinin-1 antagonists.

**Local anesthetics**
The site of action for local anesthetics administered in the epidural space is primarily the spinal nerve roots. Local anesthetics result in autonomic, sensory & motor blockade. Bupivacaine is the most commonly used local anesthetic due to its longer duration of action of 4-6 hours. Bupivacaine is available in .5% (5mg/ml) and .75% (7.5mg/ml) preservative free formulations. A new vial should be opened for each patient and sterile technique used. Local anesthetics should be injected slowly as injection rate may affect cranial migration of the drug.

Dose: .2ml/kg blocks up to L1, onset of action may take 20 – 30 minutes, the surgical side should be placed in a dependent position.

**Opioids**
The site of action for epidurally administered opioids is the opioid receptors in dorsal horn of spinal cord. They provide segmental analgesia without sensory, sympathetic or motor blockade. Morphine is the most widely used and studied since its lipid solubility profile make it the most optimal for epidural administration. It is the least lipid soluble of the commonly used opioids and therefore, it has the slowest onset of action (up to 60 minutes) but the longest duration of action (up to 24 hours). The more lipid soluble opioids
such as fentanyl provide a faster onset of action, however, since they also have more rapid systemic uptake, they have a shorter duration of action and require higher doses, similar to systemic doses. Preservative free morphine is recommended.

Dose: .1-.3 mg/kg (.1 - .3 ml/kg)

**Local anesthetic/opioid combinations**

Using the two drug classes together is reported to have a synergistic effect with improved degree and duration of analgesia at subanalgesic doses. The total dose is divided in half for each drug administered.

**Complications**

Reported complications with the epidural administration of opioids include: respiratory depression, pruritis (reported in humans), delayed hair regrowth and urinary retention. Urinary bladder management should include emptying the bladder at the time of surgery (expression or urinary catheterization) and monitoring bladder size every 4-6 hours post-operatively. Since opioids can decrease urine production AND increase urinary sphincter tone, if a patient is not urinating on its own by the morning following surgery, the cause must be investigated. Caution should be used when attempting to express a full bladder in a patient that has had an epidural; passing a urinary catheter or partial/full opioid reversal may be preferred to avoid urinary bladder rupture.

**Epidural catheters**

Epidural catheters may be placed to provide longer term anesthesia/analgesia such as multi-trauma vehicular trauma. Epidural catheter kits are available from Mila International for $39.00. They are available with a 20 gauge catheter with either a 3” or 6” Tuohy needle introducer. An instructional video on epidural cathether placement is also available for $20.00

**Caudal epidural techniques**

A caudal epidural technique at the sacrococcygeal or between the first two coccygeal vertebra has been described to help relieve urinary obstruction in cats. It may also be used to provide anesthesia/analgesia to the perineum, penis, urethra, colon, and anus by blocking the pudendal, pelvic, and caudal nerves without loss of motor function to the hind limbs. Preservative free lidocaine or bupivacaine (0.1–0.2 mL/kg) may be used depending on the duration of anesthesia/analgesia needed.

The seminar will also cover common peripheral nerve blocks including: retrobulbar, dental (maxillary, infra-orbital, mandibular and mental), testicular, declaw, intercostal, intra-pleural and femoral/sciatic nerve blocks. Wound infusion catheters will be covered in a separate seminar and proceedings.

**Femoral/sciatic local block as alternative to epidural**

Femoral and Sciatic local nerve block techniques have been found to be a practical alternative to epidural techniques. These blocks produce less urine retention and reduce opioid consumption in the 24 hours after surgery.

**References**


O’Hearn, Angela K and Wright Bonnie D. Coccygeal epidural with local anesthetic for catheterization and pain management in the treatment of feline urethral obstruction. JVECCS. 21(1) 2011, pp 50–52
