A Review of Local Anesthesia Techniques and Applications in Food Animal Practice

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Abstract:

Local analgesia is particularly useful in food animal practice, as surgical procedures can be carried out satisfactorily under local anesthesia. Operation on standing animals also eliminates dangers associated with casting, restraint, and prolonged recumbency. Extremely depressed animals, will often times tolerate a surgical procedure under local anesthesia much better than systemic anesthesia, making procedures safer as well as more economical to perform. The following techniques are not difficult to learn and do not involve the use of expensive or complicated equipment. The following local blocks will be discussed: Peterson, retrobulbar, cornual, Bier's, caudal epidural, parasacral, paravertebral, and pudendal.

Keywords:

Analgesia, Peterson, Retrobulbar, Cornual, Bier, Epidural, Sacral Paravertebral, Pudendal

Objectives:

- Review the mechanism of action of commonly used local anesthetics
- Identify techniques and practical applications for regional anesthesia in food animals

Intoduction:

Regional anesthesia was originally performed by compressing peripheral nerves over an extended period of time to cause profound long lasting anesthesia, distal to the site of compression. This method of nerve compression was described in the 16th century by the French military surgeon Ambroise Pare (1). Use of analgesics in veterinary medicine became particularly popular in the early 20th century. Epidural anesthesia in the bovine was first introduced by Benesch of Vienna in 1926 and soon became very popular for obstetrical procedures (2).

Local anesthetics consist of a lipophilic and a hydrophilic portion separated by a connecting hydrocarbon chain. An ester (-CO-) or an amide (-NHC-) bond links the hydrocarbon chain to the lipophilic aromatic ring. The hydrophilic group is usually a tertiary amine, such as diethylamine, whereas the lipophilic portion is usually an aromatic ring, such as para-aminobenzoic acid. The nature of this bond is the basis for classifying drugs that produce conduction blockade of nerve impulses as ester local anesthetics or amide local anesthetics. Some examples of esters are procaine, cocaine, chloroprocaine, pipericaine and tetracaine. Some examples of amides are lidocaine, mepivicaine and bupivacaine. The mechanism of action of local anesthetics is through the blockade of nerve conduction by inhibiting the influx of sodium ions through ion-selective sodium channels in nerve membrane leading to impairment of the generation of action potential. The sodium channel itself is a specific receptor for local anesthetic

molecules (3). The following descriptions and images are based on Dr. M. Edmondson's chapter in Dr. H. Lin's Farm Animal Anesthesia text with author approval (4).

Retrobulbar Eye Block:

Nerves Affected: Sensory and Motor to oculomotor, trochlear, abducens, and three branches of the trigeminal nerve branches (ophthalmic, maxillary, and mandibular).

Landmarks: Point of injections are medial and lateral canthus of the eye or the upper and lower eyelids at the orbital rim.

Procedure: An 18-gauge, 15 cm needle is bent slightly in order to facilitate passage around the globe and introduced through the eyelid or canthus at the orbital rim, making sure to deflect the globe with a finger to protect it from the needle. While advancing the needle slowly toward the back of the orbit, 15 ml of local anesthetic is introduced in small increments. Care should be taken to avoid penetration of the globe, orbital hemorrhage, damage to the optic nerve and injection of local anesthetic into the optic nerve meninges.

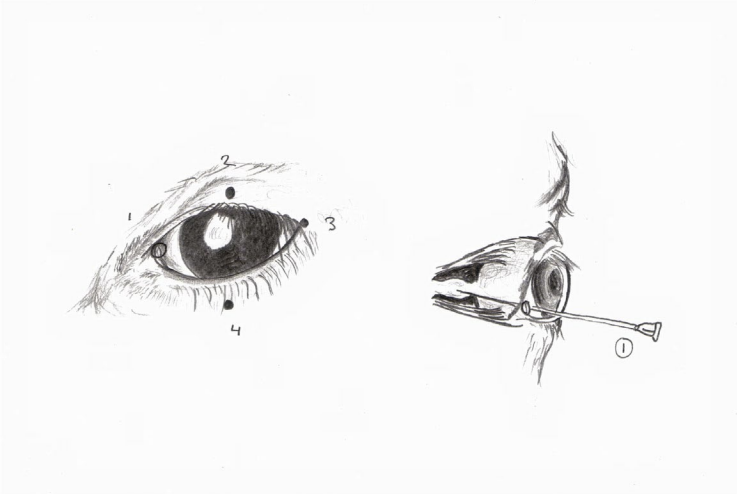

Figure 1: Depicts the injection sites for the Retrobulbar nerve block. (Illustration by Kim Crosslin.)

Peterson Eye Block:

Nerves Affected: Sensory and Motor to oculomotor, trochlear, abducens, and three branches of the trigeminal nerve branches (ophthalmic, maxillary, and mandibular).

Landmarks: Point of injection is the notch formed by the supraorbital process cranially, zygomatic arch ventrally, and the coronoid process of the mandible caudally**.**

Procedure: Inject 5 ml of local anesthetic subcutaneously at this site using a 22-gauge, 2.5-cm needle. A 14-gauge, 2.5-cm needle serves as a cannula and is placed through the anesthetized area as far anterior and ventral as possible in the notch. A straight 18-gauge, 10- to 12-cm needle is inserted into the cannula and directed horizontally and slightly caudally until it comes into contact with the coronoid process of the mandible at approximately 2.5 cm below the skin. The needle is then gently manipulated rostrally until its point passes medially around the coronoid process. It is then advanced to the pterygopalatine fossa rostral to the solid bony plate that is in close proximity to the orbital foramen at a depth of 7.5–10 cm. Penetration of the nasopharynx and turbinates should be avoided. Aspirate to ensure that the ventral maxillary artery has not been penetrated. Approximately 15 ml of local anesthetic is then injected. Both the retrobulbar block and the Peterson eye block prevent blinking for several hours. The cornea must be kept moist if these blocks are used for procedures other than enucleation.

Figure 2: (E) depicts the injection site for the Peterson nerve block. (Illustration by Kim Crosslin.)

Cornual Nerve Block:

Nerves Affected: Ophthalmic division of trigeminal nerve (corneal branch of lacrimal nerve or zygomaticotemporal nerve) in cattle and cornual branch of lacrymal nerve and corneal branches of the infratrochlear nerve in goats.

Landmarks: Point of injection in cattle is midway between lateral canthus of the eye and the base of the horn along the zygomatic process on the upper third of the temporal ridge, about 2.5 cm below the base of the horn. In cattle with well-developed horns, additional infiltration along the caudal aspect of the horn can be used in a partial ring block fashion to affect subcutaneous branches of second cervical nerve. Additionally for goats, the second point of injection is a line block midway between medial canthus of the eye and the medial horn base.

Procedure: In cattle, 5-10 ml of local anesthetic is administered subcutaneously and relatively superficially, approximately 0.7-1 cm deep. Onset of anesthesia is within 10 minutes and duration is approximately 1 hour. The same method can be applied to goats using 3-5 ml of local anesthetic but is contraindicated in kids because of the tendency for a total overdose due to their small size.

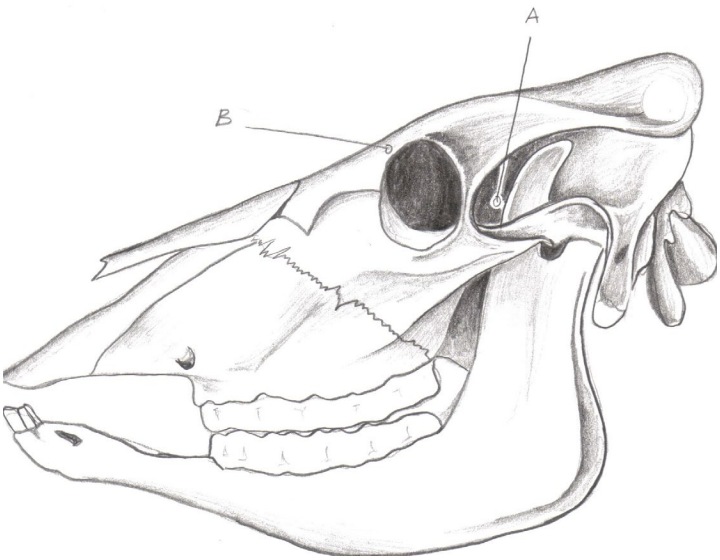

Figure 2 & 3: (A) Depicts the injection site for the Cornual nerve block in cattle. (B) is the site of the infratrochlear nerve and should be included for dehorning in goats. (Illustration by Kim Crosslin.)

Bier Block:

Region affected: Distal limbs below the placement of the tourniquet.

Landmarks: A tourniquet is placed proximal to the fetlock. In the thoracic limb, the dorsal metacarpal vein, plantar metacarpal vein, and radial vein can be used for injection. In the pelvic limb, the lateral saphenous vein or lateral plantar digital vein may be used. It is only necessary to inject anesthetic into one vein for effective anesthesia to the entire area below the tourniquet. In small ruminants, it may be difficult to use the dorsal digital vein or the palmar (plantar) digital veins; as a result, the tourniquet can be placed above the elbow in the forelimb or below the tarsus in the hind limb to allow use of the larger cephalic and recurrent tarsal veins.

Procedure: For intravenous regional anesthesia, 20 ml of local anesthetic is injected intravenously as close to the surgical site as possible. The use of a 20-gauge, 3.3 cm needle or a 21-gauge butterfly catheter may be used. Anesthesia occurs within 10 minutes and the area is anesthetized until the tourniquet is removed. The tourniquet can remain safely on for 1-1.5 hours in order to provide hemostasis during the procedure. In small goats where the placement of the tourniquet is altered as previously stated, 3-4 ml of 2% lidocaine hydrochloride is adequate to produce limb anesthesia while the tourniquet is in place. Some problems can arise due to inadequate or prolonged tourniquet time, causing failure to take effect or long term damage.

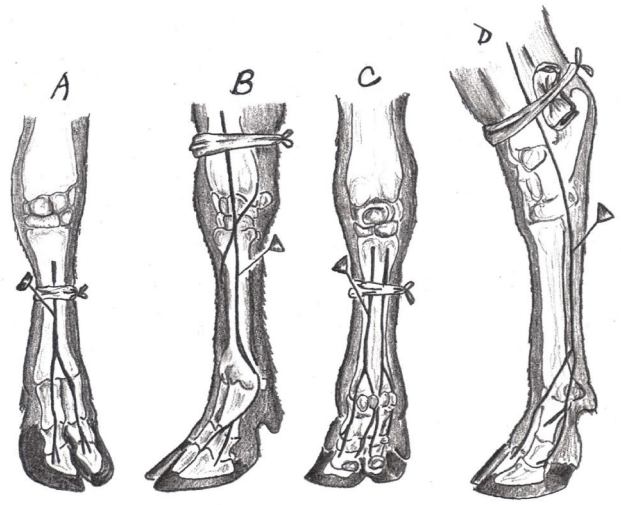

Figure 4: (A) Injection sites for regional intravenous anesthesia (Bier nerve block) common dorsal metacarpal vein of the forelimb, (B) lateral palmar digital vein, (C) lateral palmar metacarpal vein, and (D) lateral saphenous vein of the hind limb. (Illustration by Kim Crosslin.)

High Volume epidural: (Caudal epidural and Continuous caudal epidural anesthesia)

Nerves affected: Sacral nerves S2, S3, S4, and S5 for a high caudal epidural at sacrococcygeal space. Sacral nerves S3, S4, and S5 for a low caudal epidural at the first coccygeal space.

Landmarks: Point of insertion is the fossa between the last sacral vertebra and the first coccygeal vertebra or between the first and second coccygeal vertebrae for high and low versions, respectively.

Procedure: The tail should be moved up and down to locate the fossa. An 18-gauge, 3.8 cm needle without the syringe attached should be directed perpendicular to the skin surface. After penetrating the skin, a drop of local anesthetic is placed in the hub of the needle, then the needle should be advanced slowly until the drop is drawn into the epidural space by negative pressure. The syringe can be attached to the needle and the solution can be slowly injected with no resistance. The dose for cattle is 0.5 ml per 45 kg of body weight. In the case where a continuous administration of anesthetic is needed, a catheter can be placed into the epidural space for intermittent administration of local anesthetic. If providing continuous epidural anesthesia, an 18-gauge, 5 cm spinal needle with a stylet is inserted into the epidural space at the first coccygeal space with the bevel directed cranially. To determine if the needle is in the epidural space the stylet can be removed and 2 ml of local anesthetic added. Once in the epidural space, a catheter is introduced into the needle and advanced cranially for 2-4 cm beyond the needle tip. The needle is then withdrawn and the catheter remains in place. An adapter is placed on the end of the catheter and the catheter is secured on the skin of the dorsum. Local anesthetic can then be administered as needed.

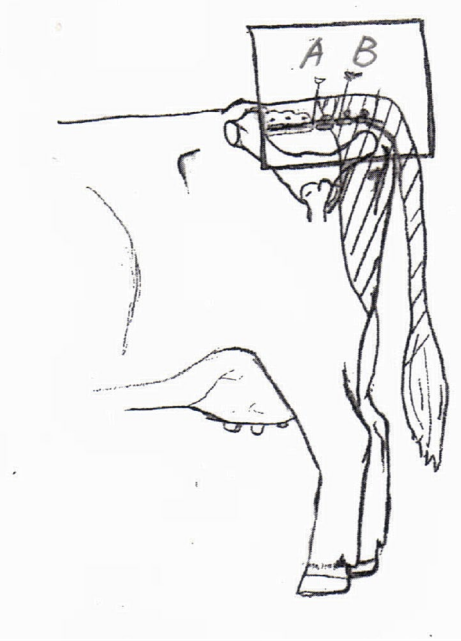

Figure 5: Caudal epidural nerve block in cattle. (A) Intersacrococcygeal space S4 and Co 1, (B) intersacrococcygeal space Co1 and Co2. (Illustration by Kim Crosslin.)

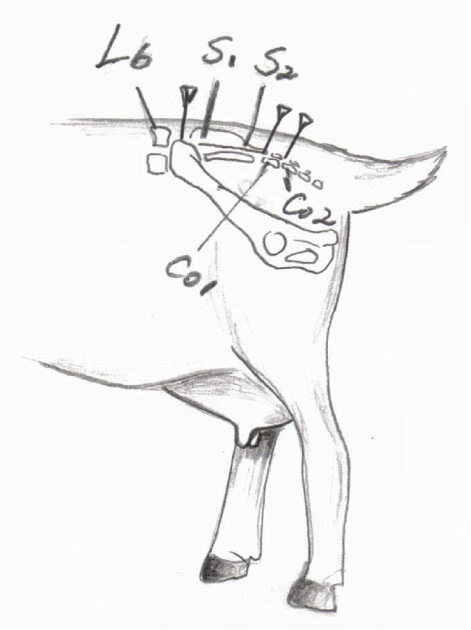

Figure 6: Caudal epidural and lumbosacral nerve blocks in goats. (Illustration by Kim Crosslin.)

Pudendal Nerve Block:

Nerves affected: Internal pudendal nerve (fibers from ventral branches of third and fourth sacral nerves and the pelvic splanchnic nerves) and the anastomotic branch of the middle hemorrhoidal nerve.

Landmarks: An ischiorectal approach is used, approaching from the ischiorectal fossa to the pudendal nerve. Placing the left hand into the rectum to the level of the wrist and directing fingers laterally and ventrally will identify the lesser sacrosciatic foramen as a soft depression in the sacrosciatic ligament. The internal pudendal nerve lies on the ligament directly cranial and

dorsal to the foramen and approximately one finger's width dorsal to the pudendal artery passing through the foramen. This pudendal artery can be palpated a finger's width ventral to the nerve.

Procedure: The skin at the ischiorectal fossa on both sides is clipped, disinfected, and anesthetized using 2 ml of local anesthetic. A 14-gauge, 1.25 cm needle is inserted into this area at the ischiorectal fossa to act as a cannula. With your right hand, an 18-gauge, 10-15 cm spinal needle is directed through the cannula and directed medial to the sacrosciatic ligament and directed cranioventrally. Once the needle has been introduced roughly 5-7 cm it can be felt via rectal palpation and repositioned onto the pudendal nerve. Once at the nerve 20 ml of local anesthetic is deposited at the nerve. Withdrawing the needle partially and redirecting 2-3 cm more caudodorsally, an additional 10 ml of local anesthetic is deposited at the cranial aspect of the foramen in order to desensitize the muscular branches and the middle hemorrhoidal nerve. Once the needle is removed, the area is massaged to help disperse the anesthetic. This procedure is then repeated on the opposite side. Full effect of relaxation of the penis may take approximately 30-40 minutes and last 2-4 hours. Assessing the effectiveness of the block may be tested by firmly squeezing the tail of the epididymis of each testicle, where failure to retract the testicle signals adequate anesthesia.

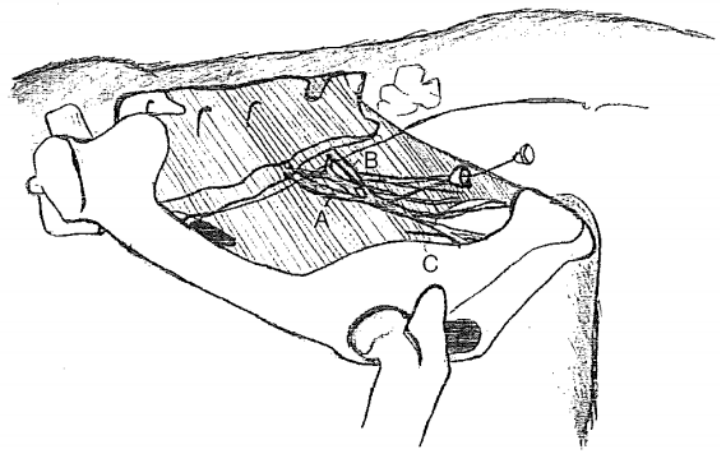

Figure 7: Internal pudendal nerve on left side of pelvis of cattle. (A) internal pudendal nerve, (B) pelvic splanchnic nerve, and (C) pudendal artery. (Illustration by Kim Crosslin.)

Sacral paravertebral Nerve Block:

Nerves affected: Pudendal nerve (pudic nerve), medial hemorrhagic nerve (pelvic splanchnic nerve), and caudal hemorrhagic nerve (caudal rectal nerve).

Landmarks: Anesthesia is produced by blocking the 3rd, 4th, and 5th sacral nerves as they branch off of the spinal cord. The paired S5 foramina are 1-2 cm lateral to the sacral coccygeal joint. The S4 foramina are approximately 3-4 cm cranial and more lateral to the S5 foramina. The S3 foramina are an additional 3-4 cm cranial to the S4 foramina. The foramina can be palpated rectally with a finger placed in or over the osseous ring.

Procedure: The skin over the dorsal sacrum is clipped of hair and surgically prepped. A stab incision is made dorsal to each foramen to help introduce a 5-7 cm 18-gauge needle. Once the

needle has entered the osseous ring, 2-3 ml of 2% lidocaine hydrochloride is injected and this process is repeated for each foramen. In order to manage tenesmus following chronic cervicovaginal prolapse or rectal prolapse, a mixture of 1ml of 2% lidocaine hydrochloride with 2 ml of 95% ethyl alcohol has been effective. In sheep and goats, an 18-gauge, 7.5 cm needle can be used in the same technique with a reduced volume of 1-2 ml of 2% lidocaine hydrochloride per injection site.

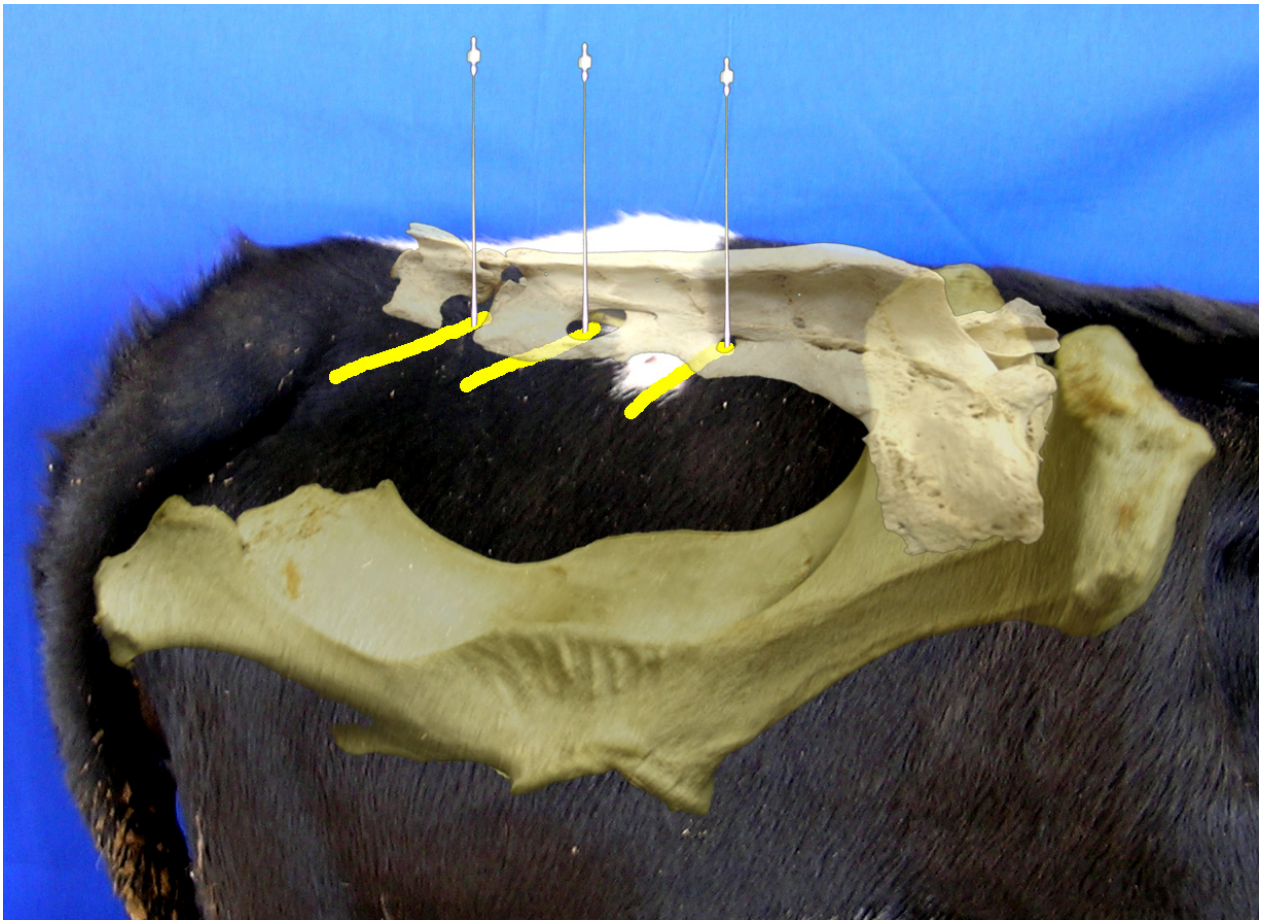

Figure 8: Photo courtesy of Dr. R. Hopper

Proximal and Distal Paravertebral Nerve Blocks:

Nerves affected: The proximal paravertebral nerve block affects the dorsal and ventral nerve roots of the last thoracic and first and second lumbar spinal nerves (T13, L1, L2). The distal paravertebral nerve block affects the dorsal and ventral rami of spinal nerves T13, L1, and L2 at the distal ends of transverse process of L1, L2, and L4 respectively.

Landmarks: For a proximal paravertebral block, to desensitize T13, cannula needle is placed at the anterior edge of the transverse process of L1 approximately 4-5cm lateral to the dorsal midline. In order to desensitize L1 and L2 the cannula needle is placed just caudal to the

transverse processes of L1 and L2. For a distal paravertebral nerve block, point of insertion is ventral and dorsal to the transverse process.

Procedure: For proximal paravertebral block, the skin at the cranial edges of the transverse processes of L1, L2, and L3 and a point 2.5-5 cm off the dorsal midline is desensitized using 2-3 ml of local anesthetic with an 18-gauge, 2.5 cm needle. To minimize skin resistance during insertion of an 18-gauge, 10-15 cm spinal needle, a 14-gauge, 2.5 cm needle can be used as a cannula or guide needle. 5 ml of local anesthetic can be placed through the cannula to anesthetize the needle tract.

To desensitize T13, the spinal needle is passed ventrally until it contacts the transverse process of L1. The needle is then walked off of the cranial edge of transverse process of L1 and advanced 1cm to pass ventral to the process and into intertransverse ligament. 6-8 ml total of local anesthetic is injected with little resistance to desensitize the ventral branch of T13. The needle is withdrawn 1-2.5 cm above the fascia or just dorsal to the transverse process and 6-8 ml of local anesthetic is infused to desensitize the dorsal branch of T13.

To desensitize L1 and L2, the spinal needle is walked off of the caudal edges of the transverse processes of L1 and L2 at a similar depth to T13's injection site and the needle is advanced roughly 1 cm to pass slightly ventral to the process and into the intertransverse ligament. 6-8 ml total of local anesthetic is injected with little resistance to desensitize the ventral branches of the respective nerve. The needle is withdrawn 1-2.5 cm above the fascia or just dorsal to the transverse process and 6-8ml of local anesthetic is infused to desensitize the dorsal branch of the respective nerve.

For distal paravertebral nerve block, an 18-gauge, 3.5-5.5 cm needle is inserted ventral to the transverse process and 10 ml of local anesthetic is infused in a fan shaped pattern. The needle can be completely removed and reinserted or just redirected dorsal to the transverse process in a caudal direction where an additional 10 ml of local anesthetic is infused in a fan shaped pattern. This pattern is repeated for the transverse processes of the second and fourth lumbar vertebrae.

The proximal paravertebral nerve block has the advantage of requiring small doses of anesthetic while providing a wide and uniform area of analgesia and muscle relaxation, decreased intra-abdominal pressure, and absence of local anesthetic at margins of surgical site. Some disadvantages include more skill required for consistent results, difficulty identifying landmarks in those obese or heavily muscled animals, and scoliosis of the spine which can make closure of the incision more difficult. Advantages of distal paravertebral nerve block include a lack of scoliosis seen with proximal method, more consistent results produced, and it is an easier method to perform. The disadvantages of the distal paravertebral block include the need for larger doses of local anesthetic required and variations in efficiency due to variations in anatomical pathways of the nerves.

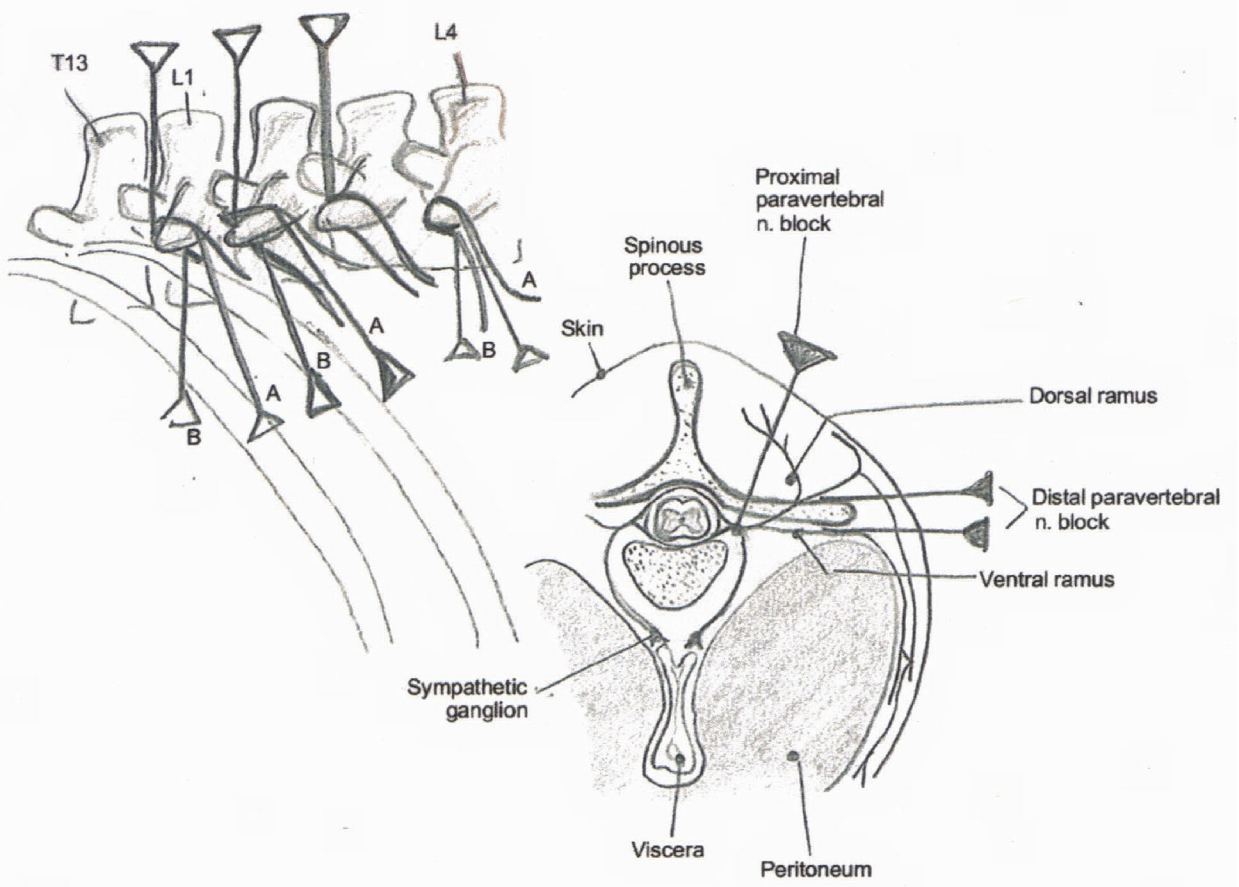

Figure 9: Illustration by: Kim Crosslin

The authors declare no conflicts of interest such as financial or personal relationships with people, organizations, or commercial interests that may influence or be perceived to influence their conclusions.

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