Anesthesia and Analgesia Minor Surgeries in Small Ruminants

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Abstract

Sheep, goats and camelids are small enough to be "manhandled" for restraint for painful procedures. In addition, their nature as prey animals makes them relatively docile and disinclined to vocalize loudly when subjected to pain, with the exception of goats. As a result, they have traditionally been handled with less attention to pain management than other species. Nevertheless, they feel pain and suffer as much as any other species and should be treated with as much care and attention to analgesia and pain management.

One of the primary goals of pain management is to prevent CNS nociceptive "windup" through preemptive analgesia. To this end, we look for drugs that decrease or prevent transmission of painful stimuli to the brain to be administered sufficiently in advance of the painful stimuli so there is minimal CNS excitation. Often this can best be accomplished by use of several drugs in combination--the so-called anesthetic or analgesic "cocktail". Other drugs may be added before, during, or after painful procedures to further modulate pain. By combined, integrated pain management we hope to bring patients through minor surgeries with minimal suffering and loss of production.

Résumé

Les ovins, caprins et camélidés sont des animaux assez petits pour être immobilisés manuellement par l'être humain en cas de procédure médicale douloureuse. De plus, leur nature de « proies animales » les rend plutôt dociles et peu enclins à « vocaliser » quand ils souffrent, à l'exception des caprins. Pour cette raison, on a toujours eu tendance à manipuler ces animaux en négligeant davantage la gestion de la douleur que pour les autres espèces. Pourtant, ils ressentent la douleur et souffrent autant que toute autre espèce et méritent autant de soins et d'attention en ce qui a trait à l'analgésie et à la gestion de la douleur.

L'un des objectifs de la gestion de la douleur est la prévention de la « poussée » nociceptive du système nerveux central (SNC), au moyen d'une analgésie préventive. À cette fin, on recherche des drogues qui diminuent ou empêchent la transmission des stimuli de douleur au cerveau, que l'on puisse administrer assez tôt avant ces stimuli pour réduire au minimum l'excitation du SNC. Souvent, la meilleure façon d'y arriver est d'utiliser une combinaison de plusieurs drogues : le « cocktail » anesthésique ou analgésique. On peut aussi administrer d'autres drogues avant, pendant ou après la procédure douloureuse pour moduler davantage la douleur. Par le biais d'une gestion combinée et intégrée de la douleur, nous espérons effectuer des chirurgies mineures sur les animaux avec le minimum de douleur et de perte de production.

Drugs and Rationale

Local anesthetics given as local or regional blocks are very useful. They block nerve transmission locally at ACE-mediated synapses, providing complete analgesia. Failures may result from inadequate infusion technique, or from anatomical differences in animals where regional blocks are used. Local anesthetic agents are inexpensive and readily available. They should not be overlooked in planning for analgesia and pain management in small ruminants.

There has been some reticence to use lidocaine in goats especially because of reported incidents of toxicity. Patients should not be denied the benefits of local anesthesia because of fear of toxic reactions. The most commonly reported upper limit for lidocaine use in goats is 2.7 mg/lb (6 mg/kg). Another study has suggested 6 mg/lb (13 mg/kg), but the lower number is taught. Even at 2.7 mg/lb (6 mg/kg), it is possible to do necessary blocks with safe levels of lidocaine in almost all circumstances. Lidocaine is usually diluted 1:1 (1%) or 1:3 (0.5%) for safer use of larger volumes. Dilution does not decrease analgesia, but may reduce duration of the block. Use of fine-gauge needles and small syringes also helps reduce the volume of lidocaine administered. For example, we usually use 25-gauge needles on tuberculin syringes for cornual blocks in kids. It is very easy to give more local anesthetic agent than needed when using larger-bore needles and larger syringes. Bupivicaine has also been used, and has the advantage of very long duration of analgesia. Use in small ruminants is often limited by the longer lag time between administration and effect, usually about 20

minutes. Estimated maximum dose for bupivicaine is 1 mg/lb (2 mg/kg).

Lidocaine injection, as supplied, has a very low pH for solubility reasons, making the solution quite painful to inject. Lidocaine may be buffered just prior to injection with 8.4% sodium bicarbonate to reduce pain on injection. Reported ratios vary, but we usually use 1 part bicarbonate to 4 parts lidocaine 2%. The results are dramatic in terms of ease of injection without evidence of pain. This is especially noticeable in goats. Buffered lidocaine may turn cloudy in the syringe, but this does not appear to interfere with efficacy of analgesia.

Applications of local anesthesia include local infiltration for suturing wounds, mass removal or lancing abscesses. Topical application to wounds, so-called "splash" blocks, are very useful. Lidocaine is not absorbed well through skin, but is taken up across mucous membranes and through open wounds in a relatively short time. Application to traumatic wounds helps with clean up and repair, and application to surgical wounds provides postoperative analgesia, especially when bupivicaine is used. Regional blocks include cornual blocks for dehorning, epidural, paravertebral and distal limb blocks. Blocks for testicles fall somewhere between local infusion and regional blocks. The Bier block for distal limb analgesia is worthy of note. In this method, a tight tourniquet is placed above the carpus or hock, if possible, after expelling blood distally by use of an Esmarch's bandage. Then local anesthetic, usually lidocaine, is injected into any vein that can be found distal to the tourniquet. One mL of 2% lidocaine per 11 lb (25 kg) would be a good rule of thumb for dose. The entire limb distal to the tourniquet is anesthetized in 10 or 15 minutes post-injection, and analgesia is profound. The tourniquet remains in place for duration of the procedure.

Cocktails consisting of an alpha 2 agonist and an opioid are the preferred option for sedation with analgesia or for pre-anesthetic medication. Combinations provide more profound analgesia with less risk of adverse effects. Many minor surgeries can be performed on this combination alone in conjunction with local anesthesia. Since none of these drugs are approved for use in small ruminants, doses are empirical, but there is a fairly wide body of experience from which to draw. In general, about one-half the dose of drug used alone is sufficient when used in combination.

Xylazine, the most commonly used alpha 2 agonist, causes deep sedation and very good analgesia. It is available in two concentrations, 100 mg/mL and 20 mg/mL. Since small ruminants, especially sheep and goats, are very sensitive to this drug, the dilute solution should always be used. Intravenous administration results in rapid onset of sedation and analgesia with more rapid recovery. With the availability of good reversal agents, intramuscular injection may be preferable due to perceived smoother response. A wide variety of doses are reported, depending on degree of sedation desired. This can vary from standing mild sedation to lateral recumbency. Doses for sheep and goats range from 0.005 mg/lb (0.01 mg/kg) IV for light standing sedation to 0.1 mg/lb (0.2 mg/kg) IM for recumbency of an hour's duration. Goats are bit more sensitive than sheep. Camelids require higher doses, ranging from 0.05 to 0.2 mg/lb (0.1 to 0.4 mg/kg). When beginning to use these drugs, it is advisable to start with a conservative dose until one develops a feel for level of sedation provided. A reversal agent should always be on hand. Be aware that reversal of sedative effects also reverses analgesic effects of the alpha 2 agonist. Adequate withdrawal time for meat or milk should be established. The Federal Animal Residue Avoidance Databank (FARAD) is the best resource for withdrawal data.

Detomidine and medetomidine are also used. There is less data available for these drugs, but medetomidine shows considerable promise, especially given safe and effective reversal with atipamezole. Medetomidine has been given at 4.5 to 9 micrograms/lb (10 to 20 micrograms/kg) IM in combination with butorphanol intramuscularly and up to 18 micrograms/lb (40 micrograms/kg) alone. In small animals, at least, medetomidine appears to be more predictable and to have fewer unintended side effects than xylazine. Cost is a factor in the US, but the very small doses used may make it a viable option for small kids, crias and lambs. The availability of atipamezole as a very specific reversal agent is also of benefit.

Butorphanol is the most commonly used opiod in small ruminants. The 10 mg/mL equine injectable is the product of choice. Butorphanol alone at 10 mg IM per llama has long been used for mild sedation. Treated animals show little outward evidence of sedation, but are much more tolerant of annoying procedures like shearing or foot trimming. In combination with xylazine it can be used at 0.05 mg/lb (0.1 mg/kg) in camelids or 0.005-0.01 mg/lb (0.01-0.02 mg/kg) in sheep and goats. It is seldom used alone in goats. Few complications are seen from use of butorphanol. Again, withdrawal time should be estimated with help from FARAD. Buprenorphine and morphine have also been used in small ruminants. Not much data is available except by personal experience, but buprenorphine has been given at 2.7 micrograms/lb (6 microgams/kg) IV for pain relief in sheep. Buprenorphine is less effective in combination with xylazine because of its longer absorption time. If given for postoperative pain control, opioids are better used IM or SC for longer duration of action.

Ketamine has been widely used for immobilization and general anestn sia in small ruminants. Doses are

available. Although there is some argument, most agree that ketamine and other dissociative anesthetics provide little or no analgesia for acute pain. Therefore, ketamine or tolazoline alone should not be used for pain management. When pre-medicated with one of the above combinations, ketamine may be used at quite small doses IV for short-term anesthesia or intubation.

Non-steroidal anti-inflammatory drugs (NSAIDs) are also useful both for pre-anesthetic pain modulation and for ongoing pain management. Aspirin has been used in sheep and goats at doses around 45.5 mg/lb (100 mg/kg) PO BID. Flunixin is the only contemporary NSAID with indications for a ruminant or food animal. It has been used IV at 0.5-1 mg/lb (1-2 mg/kg) every 24 hours for pain management. Injectable flunixin has a very high pH and can cause extensive tissue damage when given IM. This route is not recommended. There is evidence that oral administration of paste form flunixin is effective at 0.5-2 mg/lb (1-4 mg/kg) daily in goats, and presumably sheep. It has been used in camelids intravenously and orally at equine doses. A host of other NSAIDs are available, but little data exists on their use in these species. Meloxicam is approved in Europe for use in cattle at 0.22 mg/lb (0.5mg/kg) IV or SC one time for three days' duration. Since most NSAIDs are well absorbed orally in ruminants, it would be reasonable to believe we could use this orally as well. This might be a good option for smaller animals (kids, lambs, crias). European withdrawal for cattle is 5 days for milk, and 15 days prior to slaughter. Phenylbutazone has been used in small ruminants. However, its use is prohibited in lactating dairy cows and should presumably be avoided in milking goats or sheep. Establishing a withdrawal time for others would be difficult.

Procedures

Disbudding kids. Xylazine 0.05 mg/lb (0.1mg/kg) or medetomidine 4.5 mg/lb (10 mg/kg) with butorphanol 0.05 mg/lb (0.1 mg/kg) IM. Note that when drawing up such small doses together in a syringe, one should draw the butorphanol first, followed by the alpha 2 agonist. There is a certain amount of drug that is held in the hub of the syringe and drawn in with the second medicine. It is better to have a little too much butorphanol than xylazine. Block horn buds with 0.1 to 0.2 mL of 1% lidocaine at two sites for each horn: one-half way between the eye and ear and one at the medial third or dorsal brim of the orbit where there is a palpable notch in the bone. Use a tuberculin syringe and 25 g needle and fan injection, especially over the eyebrow. Clip around the horn bud. Preferred tool is the Portasol butane dehorner, but small electric dehorners are also acceptable. The procedure is best done at three days of age.

Dehorning older goats. Use the same analgesic protocol as kids, except scale up the amount of 1% lidocaine. Ring block around horn base may be added if cornual blocks not adequate. An incision in the skin around the base of the horn with a #10 blade is helpful to align the cut. Smaller horns may be removed with a small Barnes dehorner, with caution. Larger horns are best done with a wire saw (Gigli or OB wire). It is helpful to have an assistant stabilize the head while cutting. Hemostasis, if needed, can be provided by "pulling" arteries or very judicious use of a hot dehorner. Dilute epinephrine will help reduce smaller bleeders. Large horns leave large wounds which should be bandaged with Telfa, some gauze padding and creatively wrapped elastic bandage or a stockinette "hood". Postoperative analgesia is recommended. Clients should be warned in advance about the extent of the wound to be expected.

Castration of baby lambs and kids. Castration of young stock has long been done with no attempt at pain management. While sedation may not be necessary, judicious use of local anesthesia takes little time or money and can improve the quality of the procedure. This operation is best done at three days of age as well. 1% lidocaine may be injected in each spermatic cord at about 0.5 ml per cord, or lidocaine may simply be injected into the testes until resistance is felt. It may also be injected around the base of the scrotum subcutaneously. Technique varies with preference of the operator. One small study suggested that use of an emasculatome followed by use of a castrating band produced the least rise in endogenous cortisol. A good small emasculatome is available from Premier Sheep Supply.

Castration of older rams and bucks. This should be considered a major surgery and appropriate sedation and analgesia should be provided. Butorphanol plus an alpha 2 agonist is given IM, followed by good local anesthesia either in the cords or directly in the testes. If given in the testis, a minute or two should be allowed for anesthesia to diffuse throughout the organ and cord. A little 1% lidocaine around the base of the scrotum SC will also help. Typically the distal third of the scrotum is removed or the scrotum split laterally 1/2 to 2/3 its length. The cord is cut and crushed with an emasculator; several types are acceptable. Goats in particular tend to bleed even with the use of a good emasculator. The cord may be ligated with absorbable monofilament suture using a modified miller's knot. Large banding tools designed for cattle have also been used for larger rams and bucks with good effect. It is imperative that the band be sufficiently tight and the operator well trained. Tetanus protection should be established for all the above procedures, but is especially important if a large bander is used. Follow up analgesia may be indicated.

Castration of camelids. There are many techniques, but I propose the following. Administer Xylazine 0.2 mg/lb (0.4 mg/kg) plus butorphanol 0.05 mg/lg (0.1 mg/kg) IV in one syringe. Recumbency will follow in a few minutes and the upper hind leg may be tied up. 2% lidocaine is given either in the testicles or in the cords and a line block is done along the median raphe. A single incision is made along the raphe and each testis extracted and emasculated with a small White's or other emasculator. A few drops of lidocaine are placed in each side of the incision. Tolazoline may be given at (0.5 mg/lb) 1 mg/kg slowly IV for arousal, but patients will typically be up in 10 to 20 minutes and show little sign of discomfort. Again, tetanus protection should be established. Under this protocol, the patient is not under general anesthesia and will respond to painful stimuli. If local anesthesia is used, there will be no response to incision or emasculation.

Tail docking baby lambs. This is another procedure typically done without regard to pain. In this case, a very small epidural can make an enormous difference. In most lambs done at three days of age, 0.1 to 0.15 mL of 2% lidocaine in the sacrocaudal space will provide complete analgesia without ataxia. The angle of approach is about 30 degrees from the horizontal, and the vertebral canal is very shallow. There is a bit of a learning curve for these, but it is well worth it. Lambs so treated will run back to their mothers and begin nursing immediately after the procedure. The preferred technique for tail docking is the "hot knife", but we believe these are no longer manufactured. If you can find one, it is important to cut slowly through the tail to ensure good cautery. Alternately, tails can be docked using an emasculatome and knife or a rubber band. Large commercial producers are not likely to adopt this procedure, but smaller operators may and it is a great service for those with backyard or pet flocks.

Wounds, lumps, biopsies, abscesses. Most of these conditions can be addressed in a standing, awake animal with good local anesthesia. Lidocaine should be buffered with sodium bicarbonate for ease of injection. Diazepam at 5mg (1 mL) per goat given IV is very helpful in quieting vocalization and movement in that species, although it provides no analgesia. Splash-blocks of lidocaine on wounds prior to infiltration around the edges will make that process easier and less painful. For large wounds, it may be necessary to dilute lidocaine to avoid exceeding maximum dose. Do not be intimidated by large wounds in sheep and goats—they are very tough and can survive terrible bites and tears if given sufficient supportive care.

Vaginal, uterine, and rectal prolapses. Anesthetic approach to all of these is similar. Epidural anesthesia/analgesia is provided by lidocaine plus xylazine injection. The dose is 2 mL 2% lidocaine plus 0.25 mL xylazine (20 mg/mL) per 160 lb ewe. This dose is just barely short of causing ataxia. Accurate weights are needed, and if not possible always dose estimated weights low. Xylazine is added to provide longer duration of analgesia to prevent post-procedural straining as long as possible. Injection is given at the sacrocaudal junction or the first intercaudal joint. A 1-inch, 20-gauge needle is ideal. The approach is about 30 degrees from the horizontal and the space is quite shallow. It may be a bit of a learning curve, but a successful block makes for a much better outcome. Response is almost immediate. Approach in the goat is similar, with dose titrated to the size of the animal. Once the block has taken effect, the prolapse is reduced and sutures or retainers applied as necessary to keep the prolapse from recurring. It may be helpful to infuse a little lidocaine topically into the vagina or rectum to help reduce the urge to strain for a while.

Caesarean section in the ewe or doe. While not exactly a minor surgery, caesarean can be performed in the standing animal with excellent results. Administration of 5 mg of diazepam IV per goat will help keep the animal quiet while preparation and blocks are done. A simple lidocaine epidural may be advised to help prevent straining during surgery, if labor is already in process. Left flank local anesthesia is provided by paravertebral block. The back is clipped and scrubbed from the last rib to the third lumbar lateral process, from the dorsal midline 3-4 inches lateral. In all but the fattest specimens, a 1.5-inch, 20-gauge needle is sufficient. The first and second lateral processes are identified. The first may not be palpable in heavier animals, but its location can be estimated. Injections are given just cranial and caudal to the first process and just caudal to the second, about 1.5 inches from the midline. The needle is "walked" off the edge of the transverse process and drops through the ligament. 2-3 mL of 1% lidocaine is injected below the ligament and 1 – 1.5 mL above it at each site. If successful, the back will bow with the convex side toward the block. It takes a few minutes to effect. There is also a learning curve with this technique, but it is well worth learning. If done properly, this technique provides better analgesia and uses less local anesthetic agent than a line or inverted L block. The left flank is prepared for surgery as the block is taking effect. For goats or sheared sheep, two small spots on the back may be clipped and a little dilute lidocaine infused SC. These spots are used to attach towel clamps for the drape. A 9-inch drape is placed over the left flank and a vertical incision made in the paralumbar fossa. The peritoneal membrane is not anesthetized, therefore there may be a flinch as it is

entered. The uterus is exteriorized by grasping a hock or carpus and bringing it through the incision. If the uterus is very tightly contracted around the fetus, epinephrine may be given IM or IV at about 1 mL per 100 lb for relaxation. Once exteriorized, the uterus is then incised and the kid or lamb extracted while keeping the uterine incision outside the body. If there are twins or triplets, getting them from the far horn through the uterine bifurcation and out the incision may take some manipulation. This should be done gently, as nociceptive stretch receptors in the uterus are still active. The uterus is closed with surgeon's choice of absorbable suture in a single layer Utrecht pattern. The peritoneal cavity may be lavaged with sterile saline if there is concern about contamination. The body wall is closed with two layers of absorbable suture, and the skin is closed with nonabsorbable suture in a Ford interlocking pattern. Lidocaine may be splashed in the incision during closure. Flunixin is given intravenously, and follow-up analgesia provided as needed.

General Anesthesia

For procedures more complicated than can be addressed with sedative analgesia and local anesthesia, general anesthesia with isoflurane is recommended. Fasting the animal for 24-48 hours prior to surgery is ideal if possible. Pre-anesthetic sedation and preemptive analgesia can be provided with the same combinations listed above. Atropine is not usually necessary, although anesthetized small ruminants produce prodigious amounts of saliva.

It may be possible to intubate a sheep, goat, or camelid directly if deeply sedated with xylazine and butorphanol or equivalent. More frequently, they are masked with isoflurane after sedation until ready to intubate. It may be possible to "blind" intubate, but more commonly a laryngoscope is used. The largest commercially available Miller blade is adequate for sheep and goats, or small camelids. Special blades are made for larger camelids. The jaws are held open by an assistant using a loop of gauze or twine around each jaw, and the head extended upward and outward. A few drops of lidocaine on the glottis may help, but is not usually necessary. Dog-sized endotracheal tubes are adequate for sheep and goats, while foal nasotracheal tubes are often used for larger camelids. The cuff is inflated snugly, as there is always risk of regurgitation. The head should be kept low and a stomach tube passed to relieve gas pressure in the rumen and prevent regurgitation.

Anesthetized ruminants should be monitored closely and kept as light as possible. Pulse oximeters can be attached to the tongue, rectum, or sometimes to a teat. Amplified esophageal stethoscopes provide a simple and inexpensive way to monitor heart and respiratory rate. It is particularly important to monitor these patients through recovery. The endotracheal tube should be left in place and inflated until the last possible moment. If regurgitation has occurred, the tube may be removed with cuff still inflated in order to sweep out any debris in the distal trachea. Small ruminants appear to be slower than dogs and cats in "blowing off" isoflurane, perhaps because of sequestration in the rumen gas cap, so they should be monitored well past removal of the tube. Postoperative analgesia should be provided for major surgical procedures.

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