

## **SMALL RUMINANT ANESTHESIA**

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Sheep and goats are the most commonly presented small ruminants. Unfortunately, these animals do not always make the best candidates for either surgery or particularly anesthesia. Because of their unusual anatomy and physiology, general anesthesia and even heavy sedation can be complicated and life threatening. Not only are the anesthetic drugs sometimes an issue, but complications associated with the stomach and digestive systems of small ruminants need to be considered as well. Sheep and goats are adept at masking illness, as are many of the prey animals, and can be sick without showing clinical signs. Therefore a good physical exam is of utmost importance. The doses of most of the anesthetic drugs are also very different from other species.

The four-stomach configuration of small ruminants and the fermentation action that makes up the digestive process can be compromised when these animals are placed in either lateral or dorsal recumbency. Because sheep and goats re-masticate and re-chew their food along with the fermentation, the rumen is usually very full. When the patient is put into either lateral or dorsal recumbency, regurgitation of rumen contents can occur. This regurgitation can then lead to aspiration. Increased salivation when the patient is under anesthesia can also cause aspiration. Eructation is impeded and gas accumulates causing bloating. Bloating can be severe if there is a large amount of ingesta in the stomach and/or if the anesthetic event is extended. Regurgitation, increased salivation and bloat can be seen in heavy sedation and all planes of general anesthesia, but can be held to a minimum by taking a few precautionary steps.

First, the anesthetist should fast the patient for 24 hours in adults and 2-4 hours in kids or lambs less than 1 month old. This makes the stomach contents the correct consistency for minimal regurgitation. Fasting also helps decrease the pressure exerted by the stomach on the diaphragm and helps increase ventilation. Water should be withheld for 6-12 hours. Proper positioning and endotracheal intubation should be considered crucial in small ruminants that are anesthetized.

Local anesthesia and analgesia as well as nerve blocks are alternatives to general anesthesia and are often very effective. The most common of these are the corneal nerve block used for dehorning, epidural anesthesia and analgesia for surgeries performed caudal to the diaphragm or intravenous regional anesthesia used in surgery of the limbs.

If the anesthetist chooses general anesthesia, the animal's use has to be determined. There are many laws prohibiting or outlining the use of most of the available anesthetic drugs. Sedatives and tranquilizers cannot be administered to food animals. However many of the drugs in this class are appropriate choices for use in the small ruminants. Acepromazine (0.05 – 0.1 mg/kg IV, IM, SQ) provides light sedation for 2-4 hours. However, it can have long onset and elimination times and prolonged recovery.

The alpha2 class of drugs, such as xylazine and medetomidine, can be used to achieve light to heavy sedation. The depth of sedation is controlled by dose. Because sheep and goats are very sensitive to xylazine, they need very small amounts. The 20 mg/ml preparation should probably be used to minimize the chance of overdose. Xylazine (0.02-0.2 mg/kg) and medetomidine (10-20 mcg/kg) can have side effects that vary between drug and are dose dependent.

The benzodiazepines such as diazepam and medazolam (0.2-0.3mg/kg for either drug) have a 15-30 minute duration of action that can be extended by the higher dose. However, additional or increased doses do not deepen the effect of these drugs.

Butorphanol, buprenorphine and, less commonly, meperidine are opioids being used in sheep and goats. Butorphanol (0.05-0.2mg/kg IV,IM,SQ) can be given 5-10 minutes before induction to decrease the amount of the induction drugs needed and to provide analgesia. It should be redosed after 1-2 hours. Buprenorphine (0.006-0.01 mg/kg IM or SQ), must be given 30 minutes before induction for analgesia and has a duration of action of 4 hours. This makes buprenorphine a good choice for patients during long surgeries or who are going to be painful in recovery.

Anticholinergics such as glycopyrrolate and atropine tend to cause the saliva of the small ruminant to become thick and harder to expel from the mouth as well as decreasing gut motility, so they are avoided unless the patient exhibits severe bradycardia. Then atropine can be given at a dose of 2mg/50kg IM or SQ.

All anesthetic patients should have a full physical examination and a PCV and total protein count. The results of a CBC, chemistry and urinalysis are needed in the event the patient is sick or is a geriatric. It is important to know if the ruminant is a food animal as legislation dictates which drugs are able to be used.

Premedication is not always necessary in the small ruminants as they are not often excited during induction. Butorphanol or buprenorphine are opioids that are well tolerated by the small ruminants for analgesia and muscle relaxation. Xylazine is sometimes used for premedication of sheep and goats but is not always necessary in the small ruminants and is not always well tolerated. Diazepam in combination with ketamine (6-7.5 mg/kg IV) is, in my opinion, the induction of choice. Tiletamine/zolazepam or Telazol (6-8 mg/kg IV) can be substituted for the diazepam/ketamine combination if extended duration of action is required and if analgesia is added as, unlike ketamine, telazol has no analgesic properties.

To provide safe anesthesia, when using all injectable or injectables combined with inhalant, an indwelling venous catheter should be placed. The catheter provides for the injection of both tissue irritating drugs and adjunct drugs throughout the anesthetic event as well as avoiding having to place a catheter in the event of an emergency occurring. The anesthetist has to determine the most convenient place for the catheter based on preference and procedure. With restraint and clipping both the forelimb cephalic or hind limb saphenous veins are good choices. The jugular vein can also be used in goats but is difficult in sheep due to their short, thick necks. Because it is large and superficial and easily accessed, the ear vein is good for blood collection and IV injection. Small catheters can also be put in the ear of the small ruminant.

Induction and maintenance of anesthesia can be achieved by the use of all injectable drugs or a combination of injectable premedication and inhalant maintenance. Anesthesia for short and/or non-painful procedures can be accomplished with injectable drugs for both induction and maintenance. Prolonged and painful procedures should be done under general anesthesia utilizing injectable induction and inhalant maintenance. Patients undergoing general anesthesia should be intubated so that the anesthetist can capture a patent airway. Using injectable anesthesia for these longer anesthetic periods can have the side effect of a prolonged recovery.

It is essential that the small ruminant patient be intubated during anesthesia. The animal should remain in sternal recumbency until the tube is placed and cuff is inflated. Rumen contents

regurgitated before the airway is secure must be vigorously wiped out of the patient's mouth. The cuff should be inflated only until there is a small amount of negative pressure.

For induction there are several drug alternatives.

Ketamine (6-10 mg/kg IV) can be used alone without the seizure side effect in ruminants. However, smoother induction, muscle relaxation and better recovery are produced when ketamine is combined with a sedative or tranquilizer. Diazepam (0.2-0.3 mg/kg IV) would be the tranquilizer of choice in the small ruminants as, although it can be used in these patients, xylazine has several adverse side effects, and overdose can occur frequently. Butorphanol can be added to these combinations to provide better muscle relaxation and analgesia.

Propofol (5-7 mg/kg IV) is a very versatile drug in the small ruminant. Because propofol is eliminated so rapidly, it is a good choice for induction of anesthesia or as a maintenance drug. It can be administered IV in periodic boluses or as a constant rate infusion (CRI dose 0.3 – 0.8 mg/kg/min). Side effects of propofol CRI are hypotension and hypocarbia so oxygen supplementation should be added.

General anesthesia is safely maintained with inhalants in the small ruminants. Isoflurane is used after injectable induction. "Masking" is not as safe as it prolongs induction, may cause struggling and does not allow for timely establishment of a protected airway. Because of cardiovascular and respiratory side effects of the inhalants, positive pressure ventilation and positive inotropic drugs may be necessary.

A small animal anesthesia machine as well as dog and cat endotracheal tubes and breathing systems can be used in most sheep and goats. Pre-medication can reduce the dose percentage of inhalant as well as the side effects. Sevoflurane causes similar side effects as isoflurane, however a higher percentage is needed as it has a lower potency. Sevoflurane, if available, would be the inhalant of choice when mask induction is necessary, especially in kids or lambs, as it has no noxious odor and facilitates a faster induction with less struggling. Nitrous oxide is contraindicated in small ruminants.

Proper positioning of the patient for surgery is crucial. The patient should be placed so that its poll is higher than its nose so that excess saliva and regurgitated material drain out of the mouth. Also, if the patient has horns, they need to be padded so as not to be broken. Fluid therapy should be instituted and continued throughout the anesthetic period and into recovery if necessary.

Patient monitoring is often a combination of manual and mechanical factors. Parameters such as eye position, palpebral reflex, mucous membrane color and capillary refill time are examples of manual monitoring. EKG, pulse oximetry, capnography and direct or indirect blood pressure measurement are examples of mechanical monitoring.

Parameters for monitoring of heart rate and blood pressure are: Heart Rate – 60-120 BPM, < 55 BPM should be treated as bradycardia. > 140 BPM is tachycardia and the cause should be treated.

Mean arterial pressure in sheep and goats should be greater than 65 mmHg and less indicates hypotension and should be addressed. An oscillometric blood pressure monitor will give accurate results placed on any leg when the correct position and size of cuff are utilized.

If hypotension does develop, fluid therapy (10-20 ml/kg/hr IV) with crystalloid fluids should be started as well as a reduction in inhalant percentage. In the event that fluid therapy is ineffective, inotropic drugs can be utilized to increase contractility, cardiac output and blood pressure. The most commonly used inotropic drug used in small ruminants is dopamine (5-7 mcg/kg/min) administered as a CRI mixed in 0.9% NaCl. Dobutamine can also be used in place

of dopamine. Ephedrine (0.03 – 0.06 mg/kg IV) can be given in a bolus dose as well. Crystalloids given at a volume 3 times that of blood loss will help combat hypotension induced by said blood loss.

Hypoglycemia is a common problem in anesthetized kids and lambs, especially those less than 3 months of age, and should be anticipated. Administration of 5% dextrose in water at 2-5 ml/kg/hr will remedy this condition.

The recovery period is almost as important to the anesthetist as the anesthetic period is in the small ruminant. Many of the complications associated with anesthesia follow into the recovery. The patient should be recovered in sternal recumbency. Propped up that way if necessary. This allows for the return of eructation and gas release. The endotracheal tube should remain with cuff inflated until the patient can chew, swallow and move its tongue. This provides protection of the airway from regurgitated material still in the animal's mouth. The cuff should remain partially inflated when the tube is removed. Most sheep and goats seem to enjoy sitting sternally until they can stand easily. The patient can eat and drink 2-3 hours after they are on their feet.

Anesthesia of the small ruminants is challenging but can be accomplished safely if the anesthetist considers all of the special attributes of sheep and goats when making his/her anesthetic plan.