# Anesthesia and Analgesia of Small Mammals

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As our understanding of the physiology of small companion mammals improves so does our ability to provide high quality veterinary care. Anesthesia and analgesia are integral components of providing high quality veterinary care and welfare for our patients. To accomplish this goal is essential to have a well-stocked pharmacy with a variety of anesthetic and analgesic pharmaceuticals so we can design custom analgesic and anesthetic plans based on the procedure and patient's needs.

First, we must understand specific definitions of terms related to anesthesia and analgesia so that e can employ them effectively.

General anesthesia = induced unconsciousness characterized by controlled reversible depression of the CNS and analgesia. Patients under general anesthesia are not arousable and the reflex functions are attenuated. Surgical anesthesia is a deeper level that allows for painless surgery.

Sedation = a state of central depression and drowsiness with the patient unaware of its surroundings.

Tranquilization = the relief of anxiety and a state of relaxation while the patient is aware of its surroundings.

Analgesia = the freedom or absence of pain.

Local analgesia = loss of sensation in a circumscribed area.

Regional analgesia = loss of sensation or insensibility in a larger but limited body area.

As prey species, most small mammals become highly stressed in new and unusual situations including visits to veterinary clinics. These animals often benefit from sedation, tranquilization, or general anesthesia to perform physical exams, diagnostic tests, or carry out minimally invasive procedures. It is also important to remember that the analgesia provided by general anesthesia is short lived (up to the point of recovery) and an analgesic protocol must be instituted in all case when painful stimuli is unavoidable. We must think of anesthesia and analgesia as being two different components of one modality, both being essential for its success.

It is important to have a wide selection of anesthetic and analgesic drugs to choose from to design protocols that fit the animal's presentation and need rather than our preference. The other advantage of having an assortment of drugs at our disposal is the ability to provide balanced anesthesia and analgesia utilizing various drugs at lower doses to achieve a smooth anesthetic event and recovery with lower risks. The practice of pre-emptive analgesia should be the standard of practice to ensure that our patient's pain level is minimized through their hospitalization. Ultimately, a more comfortable, less stressed patient is more likely to respond to therapy and do better than one that has experienced a traumatic event.

## Tranquilization and Sedation

Stressed or fractious animals often benefit from being calmed down for a physical exam, bandage change, or other non-invasive procedures. It is not always necessary to anesthetize these animals but rather provide sedation or tranquilization. The author's preferred drugs for this purpose are isoflurane, midazolam, and butorphanol. While most think of isoflurane as an inhalant used for anesthesia, it can also be used to sedate animals. Maintenance of isoflurane at 1% or less can provide enough sedation to allow bandage changes, obtaining radiographs, perform physical exams, obtain blood and other non-invasive procedures. Animals recover quickly and there are minimal risks and side effects associated with isoflurane. Midazolam is a

water-soluble benzodiazepine with a wide margin of safety that can be used for tranquilization or sedation. The higher end of the dosage may be needed for sedation and dosages as high as 2 mg/kg are reported although probably unnecessary. In the author's experience, midazolam provides good relaxation and tranquilization or sedation (based on dose) with up to 45-minute duration. It is safe and when used by itself may not require reversal. However, if reversal is needed, flumazenil is the specific reversal agent. If stocking midazolam, flumazenil should always be available for when midazolam is used as part of an anesthetic plan, but it is rarely used to reverse tranquilized or sedated patients. Butorphanol is a widely available opioid that while falling out of favor as an analgesic still has application as a sedative. A combination of midazolam and butorphanol can be used to provide good quality sedation in small mammals. An additional drug that can be used for tranquilization or sedation is alfaxalone. When used alone or in combination with butorphanol, midazolam or dexmedetomidine, it provided sedation to anesthesia in rabbits (Bradley 2019). Alfaxalone has also been shown to be effective for sedation in guinea pigs and hedgehogs when used alone or in combination with midazolam. Regardless of the drug used for tranquilization or sedation it is important to remember to also include an analgesic when performing painful procedures.

Anesthesia

The most important aspect of selecting an anesthetic protocol for small mammals is to remember to apply the concept of balanced anesthesia, which combines a variety of drugs at lower doses. This makes for a more effective anesthetic event with smoother induction and recovery and decreased side effects of individual drugs. There is a wide range of protocols published for the anesthesia of small mammals. Ketamine is commonly used in combination with diazepam, midazolam, or dexmedetomidine for pre-medication or induction of anesthesia followed by maintenance with isoflurane or sevoflurane. These are proven combinations that have worked well in many patients (Carpenter, Fish). Alfaxalone has also gained popularity and is commonly used in anesthetic protocols for small mammals, but we must keep in mind the possibility of respiratory depression when suing alfaxalone. This deleterious effect can be minimized by using lower doses (<3mg/kg) and administering IM or SC rather than IV. If administered IV, the rate of administration should be slow to help prevent the fast onset of respiratory depression. Of course, an analgesic agent should also be included with these protocols. Propofol is also an excellent choice for induction of small mammals but like alfaxalone, carries the risk of respiratory depression. Hydromorphone and buprenorphine are good analgesic choices to include as part of the anesthetic protocol.

Analgesia

Pre-emptive analgesia, or the provision of analgesia before painful stimuli occurs, is the best approach to providing comfort to our patients. By providing analgesics well in advanced before painful stimuli, we are in effect raising the pain threshold of our patients. There are two main groups of analgesics commonly used in small mammals, NSAID's and opioids. Carprofen and meloxicam have both been used with good results over the years but meloxicam is currently favored amongst most exotic animal veterinarians. Nowadays a dose 1 mg/kg SC or PO are used adequate effects in rabbits (Fredholm 2013) and other small mammals.

The second common group of drugs used for analgesia in small mammals is the opioids. Those with mu agonist properties are better suited for analgesia in mammals. Hydromorphone, buprenorphine, morphine, and fentanyl are all good choices. In order for pre-emptive analgesia to be more efficient it is best to provide analgesics hours before a procedure. The author's preference is to start analgesics 12-24 hours prior to surgery and continue administration of analgesics until at least 24-48 hours post-surgery.

Tramadol is yet to be widely used in small mammals and has fallen out of favor with most anesthetists in favor of pure opioids. While its efficacy as an analgesic is promising in rats (Zegre 2011), its use in rabbits does not appear justified at dosage tested (Souza 2008). Therefore more research is needed to determine the efficacy and proper dosage of tramadol in small mammal species.

Intravenous administration may be considered in order to reach plasma levels in a shorter period of time whenever pre-emptive analgesia is not possible such as in emergency procedures. This can then be followed by IM or SQ administration as needed. We often use a combination of NSAID's and opioids in the pre and postoperative period. Ozawa and Miller recently reviewed analgesia and pain recognition in rabbits (Ozawa, Miller). There has also been an increase in pharmacokinetic and pharmacodynamic studies in small mammals over the last decade. Yearly review of the literature is important to remain updated on the most accepted approaches to analgesia.

An additional analgesic approach is to perform local or regional blocks. Local blocks are easy to perform, inexpensive and yet may provide significant benefits to the patient. Regional blocks such as brachial plexus block and epidurals are more technically challenging and may require specialized equipment. Nonetheless, they are viable options that should be explored.
Before selecting a protocol, one must always perform a thorough evaluation of the patient and their physiologic status. The type and length of procedure, recovery, and owner compliance must also be considered when designing an analgesic plan. When used with knowledge of their properties and the patient's status, anesthetics and analgesics can be a safe and effective tool for minimizing stress and discomfort in small mammals.

Signs of Pain in Small Mammals

Inc. RR, HR
Abnormal posture
Aggression in docile animals
Passive behavior in normally aggressive animals
Closed eyes
Pressing abdomen against floor
Self-mutilation
Over-grooming
Vocalization
Anorexia
Decreased fecal production
Piloerection (fluffed up)

List of Recommended Anesthetic and Analgesic Agents to Keep in Stock

Isoflurane or sevoflurane
Ketamine
Dexmedetomidine (Atipamezole reversal agent)
Alfaxalone
Propofol
Midazolam/Diazepam(Flumazenil reversal agent)
Butorphanol
Morphine/Hydromorphone/Buprenorphine (Naloxone reversal agent)
Meloxicam
Lidocaine

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