Guidelines on Anesthesia and Analgesia in Ferrets

Last updated 15 February 2015

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1. Purpose

1. This document was created by the ULAM veterinary staff as a guideline for anesthesia monitoring during surgery and sedation. This is not intended to be an inclusive tutorial on all possible methods and all equipment available for anesthesia monitoring.

2. Current veterinary anesthesia standards of care focus on reducing anesthetic morbidity. Adverse changes in normal animal physiology can be detected and corrected early through responsible use of anesthesia monitoring equipment and trained personnel dedicated to anesthesia monitoring. For more detailed information regarding monitoring capabilities and physiological systems, please reference Anesthesia and Sedation Monitoring Guidelines.

3. Detailed information regarding pre- and post-operative care for animals undergoing survival surgical procedures as well as requirements for species specific anesthesia and analgesia are located on the UCUCA website at http://www.ucuca.umich.edu/guidesurg.htm.

4. If you have questions or comments about this document, please contact the ULAM veterinary staff at ulam-vets@umich.edu or 734-936-1696. The ULAM training core (ulam-trainingcore@umich.edu or 734-763-8039) can be contacted to provide training in these techniques at no charge.

2. Responsibility

1. Principal Investigator: Responsible to ensure appropriate anesthesia, monitoring and analgesia is provided for all animals undergoing surgical or sedation procedures.

3. Definitions

1. Anesthesia: Temporarily induces loss of sensation with or without loss of consciousness.


3. Sedation: A mild degree of central depression in which the patient is awake but calm.

1. Sedation is not sufficient for surgical procedures.

4. Procedures

1. Prior to anesthetic/analgesic/sedative event

1. Ocular lubrication such as Paralube® must be used to prevent corneal drying during anesthesia or sedation.

2. Vascular Access

1. Ferret skin is very tough and contains a lot of subcutaneous fat which makes catheterization complicated. Ease of insertion of catheter can be created by making a small knick in the skin using the beveled edge of a 20g needle or small blade. The cephalic, lateral saphenous and jugular veins can be catheterized (22g, 24g, or 26g for smaller ferrets). Small blood samples (e.g. glucose measurements) can be taken from the lateral or caudal tail vein. If larger volumes are required, they can be collected from the jugular, cranial vena cava, cephalic or saphenous veins.

2. Fasting and Endotracheal Intubation

1. Ferrets readily vomit. Young ferrets (<3 years of age) should be fasted for approximately eight hours. However, ferrets over 3 years of age should not be fasted for longer than 3-4 hours because prolonged fasting can induce a profound hypoglycemic state (Matchett et al. 2012).

2. A cuffed endotracheal tube with a 3-mm internal diameter should be used for ferrets >1kg. Small ferrets may require a cuffed or uncuffed 2.5-mm or less internal diameter endotracheal tube. Intubation is facilitated by applying 0.05ml of 2% lidocaine to the glottis to prevent laryngospasm (involuntary closure of the opening to the trachea).

4. Monitoring and Recovery

1. Standard mammalian monitoring techniques are applicable to ferrets – the goal of the monitoring should be to maintain normal cardiac function, respiratory function, ventilation, core body temperature, and depth of anesthesia. Understanding the basic physiologic effects of the anesthetics used is paramount to correctly interpreting monitoring parameters. Refer to anesthesia guidelines listed in the “Purpose” section of this document for further details.
2. Like other small mammals, ferrets are very prone to hypothermia. Moderate-to-severe hypothermia (<95°F) requires active warming. The following actions are recommended to minimize heat loss:
   1. Warm the immediate environment with circulating water blankets or heat lamps
   2. Minimize clipping hair around the surgical site
   3. Use warmed surgical scrub solution to prepare the surgical site
   4. Substitute warmed sterile saline for alcohol during surgical scrubs
   5. Cover the ferret with appropriate surgical drapes
3. Recovery should occur in a warm, quiet location. Ferrets should be observed until fully recovered from anesthesia, and monitored to assure that they have reestablished and are maintaining normal body temperature and hydration status.
4. Post surgical nutritional support can be beneficial to promoting recovery in ferrets. Contact veterinary staff (ulam-vets@umich.edu) for further information.

5. Monitoring Pain
   1. Signs of pain in ferrets may include, but are not limited to, the following:
      1. Abnormal posture
      2. Reluctance to curl into normal position
      3. Reluctance to move
      4. Dull
      5. Lethargic
      6. Elevated respiratory rate
      7. Deep respirations
      8. Hunched
      9. Arched back
     10. Teeth grinding
     11. Stilted gait

6. In the Event of an Emergency
   1. Contact veterinary staff at 734-936-1696 during business hours (Monday to Friday 8am to 5pm) or Department of Public Safety after hours at 734-763-1131.

7. Common Ferret Anesthetics and Other Agents
<table>
<thead>
<tr>
<th>Drug(s)</th>
<th>Dose/Route</th>
<th>Notes</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atipamezole</td>
<td>1mg/kg SC, IV, IP OR equal volume to administered dexmedetomidine</td>
<td>Reversal for dexmedetomidine</td>
<td>Carpenter, 2013</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.04 - 0.05 mg/kg IM, IV, SC</td>
<td>Anticholinergic (bradycardia, hypersalivation)</td>
<td>Ko and Marini, 2008</td>
</tr>
<tr>
<td>Glycopyrrolate</td>
<td>0.01 mg/kg IM or SC</td>
<td>Anticholinergic</td>
<td>Mason, 1997</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>Induction: 5%; Maintenance: 1.5 – 3%</td>
<td>Inhalant anesthetic of choice</td>
<td>Wixson, 1997</td>
</tr>
<tr>
<td>Sevoflurane</td>
<td>Induction: 8%; Maintenance: 2.5-4.5%</td>
<td>Inhalant anesthetic</td>
<td>Ko and Marini, 2008</td>
</tr>
<tr>
<td>Ketamine + Xylazine</td>
<td>10-30 mg/kg ketamine IM +</td>
<td>Minor procedures; may add an anticholinergic as premedication</td>
<td>Mason, 1997; Wixson, 1997</td>
</tr>
<tr>
<td>Ketamine + Dexmedetomidine</td>
<td>5mg/kg xylazine IM + 40 ug/kg dexmedetomidine IM</td>
<td>Minor procedures including induction; 45 min duration; may add anticholinergic as premedication</td>
<td>Carpenter 2013</td>
</tr>
<tr>
<td>Ketamine + Xylazine + Butorphanol</td>
<td>15mg ketamine IM + 2mg/kg xylazine IM + 0.2 mg/kg butorphanol IM</td>
<td>Effective for short term procedures; duration 90 min; Analgesic properties; watch for respiratory depression</td>
<td>Ko and Marini, 2008</td>
</tr>
<tr>
<td>Xylazine, Butorphanol &amp; Ketamine</td>
<td>2 mg/kg xylazine IM + 0.2 mg/kg butorphanol IM + 15 mg/kg ketamine IM</td>
<td>Effective for short term procedures</td>
<td>Ko and Marini, 2008</td>
</tr>
<tr>
<td>Tiletamine + Zolazepam</td>
<td>22 mg/kg IM</td>
<td>Excellent for most minor procedures, but long recovery time</td>
<td>Mason, 1997; Wixson, 1997</td>
</tr>
</tbody>
</table>

8. Ferret Analgesics and Local Anesthetics
<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose/Route</th>
<th>Notes</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butorphanol</td>
<td>0.1-0.5 mg/kg IM or SC every 4 hrs</td>
<td>Opiate agonist-antagonist; coverage for mild to moderate pain</td>
<td>Mason, 1997</td>
</tr>
<tr>
<td>Buprenorphine *</td>
<td>0.01-0.03 mg/kg IM, IV or SC every 8-12 hrs</td>
<td>Opiate agonist; Mild to moderate pain</td>
<td>Mason, 1997</td>
</tr>
</tbody>
</table>

Parameter

<table>
<thead>
<tr>
<th>Body Temperature</th>
<th>Heart Rate</th>
<th>Respiratory Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-104 F (37.8-40°C)</td>
<td>180-300 bpm</td>
<td>30-40 bpm</td>
</tr>
</tbody>
</table>

*Note: Buprenorphine should be used with caution due to its potential for respiratory depression.*
Bupivacaine 1-2 mg/kg diluted with saline infiltrate surgical site  Local Anesthetic Can be used pre- and post-surgery Ko and Marini, 2008

Carprofen 2-4 mg/kg SC, IM, IV, PO every 24 hrs  NSAID Ko and Marini, 2008

Flunixin meglumine 0.5-2.0 mg/kg IV or SC every 12-24 hrs  NSAID Schaeffer, 1994

Ketoprofen 1-3 mg/kg SQ, IM, IV, PO every 24 hrs  NSAID Ko and Marini, 2008

Lidocaine 2 mg/kg diluted with saline infiltrate surgical site  Local Anesthetic with 60 min duration Can be used pre- and post-surgery Ko and Marini, 2008

Meloxicam 0.2 mg/kg SC, IM, IV, PO every 24 hrs  NSAID Ko and Marini, 2008

Morphine 0.5-5.0 mg/kg IM or SC every 2-6 hrs  Opiate agonist; Mild to severe pain. Mason, 1997

Naloxone 0.04 mg/kg IV or IM once  Narcotic reversal agent Mason, 1997

Oxymorphone 0.05-0.2 mg/kg IM or SC every 6-12 hrs  Opiate antagonist Mason, 1997; Wixson, 1997

Tramadol 5 mg/kg PO every 24 hours  NSAID Carpenter, 2013

Preemptive analgesia, particularly opiates like buprenorphine, can reduce the dose of anesthetics required for surgical anesthesia and increase the respiratory depression associated with anesthetics. When pre-emptive analgesia is used, consider reducing the dose of anesthetic (whether inhalant or injectable) to the low end of the recommended range. Anesthetic depth must be carefully monitored and drug doses may need to be titrated to maintain appropriate levels. With new projects, sexes, strains or anesthetic analgesic combinations, assess a subset of animals before expanding to use in a larger cohort.

5. Related Documents
   1. Non-rodent mammal post-operative monitoring form
2. Anesthesia and Sedation Monitoring Guidelines
3. EHS Anesthetic Gases in Animal Research

6. References