Instructions for Adds/Changes to the Veterinary Anesthesia Update 2\textsuperscript{nd} Edition

**Equipment:**
Insert **Effective Capnography Monitoring for Very Small Patients** between the current page 1-24 (The Capnograph) and 1-25 (Building a Passive Scavenging System).

**Protocols:**
Replace the current pages 3-43 to 3-47 with the new **Anesthesia for Healthy Rabbits** and **Anesthesia for Fractious Cats** sections.
Replace the current pages 3-55 to 3-57 with the new **Anesthesia for Cat with Urethral Obstruction** section.
Replace the current page 3-109 with the new **Anesthesia for Canine and Feline Ophthalmic Surgery (Cont’d)** page.
Replace the current pages 3-125 and 3-126 with the new **Chemical Restraint for Canine Cardiac Ultrasound** section.

**Troubleshooting:**
Insert the **Patient has Increased Breathing Effort (Cont’d)** page between the current page 4-21 and 4-22.

**Anesthesia Drugs:**
Insert **Alfaxalone** between the current page 5-2 (Acetaminophen) and 5-3 (Atipamazole).
Insert **Bupivacaine** between the current page 5-6 (Atropine vs. Glycopyrrolte) and 5-7 (Buprenorphine)
Replace the current page 5-7 with the new **Buprenorphine** page.
Insert **Dexmedetomidine** between the current page 5-10 (Codeine) and page 5-11 (Diazepam).
Insert **Metadone** between the current page 5-32 (Meperidine) and page 5-33 (Midazolam).
Insert **Phenobarbital** between the current page 5-41 (Pentathal) and page 5-42 (Phenylephrine).
Insert **Propoflo 28** between the current page 5-46 (Propofol) and page 5-47 (Sevoflurane) and then insert the **Rocuronium** page immediately following **Propoflo 28**.

**Pain Control:**
Insert **Sacro-coccygeal Epidural Analgesia in the Dog and Cat** between the current page 6-27 (Regional Analgesia Options) and page 6-28 (Epidural Analgesia in the Dog and Cat).
Effective Capnography Monitoring for Very Small Patients

The following recommendations pertain to canine and feline patients as small as 2 kg body weight. It does not apply to birds or reptiles.

- Instead of non-circle breathing systems (Bain, Jackson Rees, Ayres T, Norman Elbow) use pediatric circles to deliver inhalant to all but the very smallest cats and puppies (any patient over 2.5 kg).

- Small patients typically have low tidal volume and high respiratory rates during anesthesia. The absence of a well-defined plateau on the capnograph display results in artificially low etCO$_2$. The accuracy of etCO$_2$ can be improved by manually delivering a single large tidal volume. This creates a plateau making the displayed etCO$_2$ after the breath more representative of alveolar gas thus providing a more accurate picture of ventilation.

- You may occasionally want to disconnect the patient from a non-circle breathing circuit (Bain, Jackson Rees, Ayre’s T, Norman Elbow) completely, leaving the capnograph adaptor in place and allowing a few moments of sampling to take place. This will temporarily eliminate the mixing of fresh gas and exhaled gases and improve the reliability of the measurements.

- Another way to improve the accuracy of side stream monitors applied to small patients breathing from non-circle breathing circuits (Bain, Jackson Rees, Ayre’s T, Norman Elbow), is to assemble a modified elbow adaptor to fit between the endotracheal tube and the breathing circuit. This will allow the sampling of exhaled gases from deeper in the respiratory tract where there will be less mixing and dilution of the exhaled gas by fresh incoming gas. (see photo below).

- Any time you do not see a distinct plateau as part of the capnograph wave form, the etCO$_2$ may not be representative of what is in the bloodstream (PaCO$_2$) and should be interpreted with caution.

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**Equipment 1-24a**
Anesthesia for Healthy Rabbits

History, signalment and preoperative evaluation:
Asymptomatic rabbits may have extensive lung pathology due to silent chronic pasteurellosis.
Survey chest x-rays should be undertaken before elective anesthesia and are mandatory for all rabbits with current or prior history of upper or lower airway disease, ocular or nasal discharge.
If an abdominal procedure is planned, consider fasting overnight with water freely available until morning of surgery/anesthesia.
Use maximal chemical restraint to avoid trauma from struggling.

Anticipated problems:
- Struggling during handling
- Difficulty placing and securing IV access
- Intubation
- Airway obstruction
- Mucus obstruction of ETT
- Monitoring anesthetic depth
- Pronounced hypothermia
- Evaluation of post-operative pain

Premedication:
Heavy chemical restraint is recommended as it allows safe handling and IV catheter placement.
The following premedication drug protocols require additional IV induction drug administration to achieve good intubation conditions:

**Protocol # 1:** (drugs can be combined in the same syringe):
Ketamine 10 mg/kg + acepromazine 0.05 mg/kg + midazolam 0.2 mg/kg + butorphanol 0.2 mg/kg (or oxymorphone 0.1 mg/kg or hydromorphone 0.1 mg/kg)-all IM preferably lumbar.

**Protocol # 2:** (drugs can be combined in the same syringe):
Medetomidine 20 ug/kg I.M (or equivalent volume of dexmedetomidine) + ketamine 10 mg/kg I.M.
Alfaxalone 2 mg/kg I.M. can be added separately if initial medetomidine/ketamine is insufficient to permit catheter placement.

**Protocol # 3:**
Medetomidine 20 ug/kg I.M. (or equivalent volume of dexmedetomidine) + ketamine 10 mg/kg I.M.
Midazolam 0.2 mg/kg - can be added separately if initial medetomidine/ketamine is insufficient to permit catheter placement.
Anesthesia for Healthy Rabbits (Cont’d)

Protocol # 4:
Ketamine 10 mg/kg I.M. + midazolam 0.3 mg/kg I.M.
Alfaxalone 2 mg/kg I.M.- can be administered separately and used as top-up if initial ketamine /midazolam is insufficient.

Once your patient is quiet and can be safely handled without stress, place a 22 or 24 gauge IV catheter in the marginal ear vein located along borders of the pinna and secure with tape. Use a small syringe case to impart rigidity to the pinna and facilitate taping.

**HINT** The ear vein may be highlighted by application of alcohol.

**Induction:**

The following IV induction protocols can be combined with any of the premedication options listed above based on clinician’s preference and experience. Be aware that apnea can occur with any of these protocols. Apnea may render intubation more difficult if you are planning to use the blind intubation techniques.

Pre-oxygenate with face mask for 2 minutes prior to and during induction.
Mask induction is discouraged as it provides poor intubation conditions and exposes personnel to excess levels of anesthetic gas.

**Protocol #1:**
Ketamine 5 mg/kg mixed with an equal volume of diazepam I.V delivered in 1/4 doses every 30 seconds until no or faint response to toe pinch.

**Protocol #2:**
Alfaxalone 2 mg/kg I.V. in increments of 0.5 mg/kg delivered every 30 seconds until no or faint response to toe pinch.
Patient’s dose requirements may be significantly reduced by premedication and apnea may occur, so titrate cautiously.

**Protocol #3:**
Propofol 5 mg/kg I.V. in increments of 1 mg/kg delivered every 30 seconds until no or faint response to toe pinch.
Patient’s dose requirements may be significantly reduced by premedication and apnea may occur, so titrate cautiously.

**Premedication/Induction combined:**

Recommended for healthy rabbits only. May benefit the anesthetist who has limited intubation skills and experience as apnea is unlikely and good relaxation is achieved making intubation slightly easier to perform.

**Option 1:**
Xylazine 2 mg/kg S.Q. + ketamine 20 mg/kg S.Q.
Duration of effects approximately 40 minutes of useful working time.
Anesthesia for Healthy Rabbits (Cont’d)

Option 2:
Medetomidine 200 ug/kg S.Q. (or equivalent volume of dexmedetomidine) + ketamine 15 mg/kg S.Q.
Longer lasting (60 minutes +) than xylazine based protocol above, so alpha 2 reversal will likely be necessary using a volume of atipamazole that is equal to the volume of medetomidine (or dexmedetomidine) that has been administered.

Maintenance:
- Isoflurane or sevoflurane equally acceptable
- Nitrous oxide contraindicated

Monitoring:
Increased respiratory effort may indicate ETT obstruction by mucus plugs or improper positioning of the distal end of the ETT against the wall of the trachea. If you suspect obstruction, squeeze the reservoir bag to remove any mucus plugs or reposition the ETT by withdrawing it slightly. You will be able to tell that obstruction has been relieved by a normalization of the breathing pattern.
Change in depth of anesthesia is evaluated by changes in breathing rate, depth, heart rate and detection of purposeful movement. Assessment of jaw tone is not a particularly useful monitoring parameter in rabbits especially if an alpha 2 based protocol is being administered.
If a rabbit vocalizes during handling, assume extreme anxiety and distress, discontinue handling and deliver oxygen by face mask. Once the patient is calm and you have re-assessed vital signs, increase the level of chemical restraint before proceeding.
Changes in breathing rate and depth are the most reliable indicators of a change in depth of anesthesia and require careful observation of the reservoir bag movement or measurement of end tidal carbon dioxide by capnography.
Capnography is an effective means of monitoring respiratory function in rabbits and other animals. Their small size dictates the need for pediatric size adaptors in order to reduce dead space. A special capnography adaptor can be configured to improve the quality of the capnograph in small mammals (see page 1-24a for more information about capnography in very small patients.)
A Doppler ultrasonic blood pressure monitor is an important and versatile monitor particularly for exotic pets: it provides an audible signal associated with pulsatile blood flow and thus allows continuous monitoring of heart rate; it allows blood pressure monitoring in larger exotic pets (e.g., rabbits, ferrets).
**Anesthesia for Healthy Rabbits (Cont’d)**

**Support:** *(as for dogs and cats, see page 3-4)*

Fluid therapy is also possible by small intermittent IV bolus administration from a syringe.

**Special instructions:**

Steps for successful atraumatic rabbit intubation:

There are five options for achieving rabbit airway protection, four of which entail placing an appropriately sized endotracheal tube, and the fifth which involves securing a laryngeal mask airway (LMA) over the arytenoid cartilages.

Intubation can be accomplished through one of the following techniques: 1) blind intubation, 2) blind intubation using a modified stethoscope to amplify breath sounds, 3) intubation using direct visualization by otoscope cone with an intra-tracheal urinary catheter as a guide, 4) intubation using direct visualization with an endoscope.

Regardless of which intubation technique you choose, follow these steps:

- Ensure sufficient depth of anesthesia to prevent swallowing reflex or laryngospasm during ETT placement.
- Select an appropriately sized uncuffed endotracheal tube, preferably one that is made of clear PVC, with a Murphy Eye.

<table>
<thead>
<tr>
<th>patient size</th>
<th>endotracheal tube size</th>
<th>special instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kg and under</td>
<td>size 1.5 mm uncuffed clear. These are difficult to find commercially and an 18 or 20 gauge IV catheter can be used instead.</td>
<td>Intubation by direct visualization recommended</td>
</tr>
<tr>
<td>between 1 and 2 kg</td>
<td>size 2 mm uncuffed clear</td>
<td>Breath sounds may be difficult to hear during intubation with this tube size</td>
</tr>
<tr>
<td>between 2 and 3 kg</td>
<td>size 2.5 mm uncuffed clear</td>
<td></td>
</tr>
<tr>
<td>Over 3 kg</td>
<td>size 3 mm or larger uncuffed clear size 1 laryngeal mask airway (LMA)</td>
<td></td>
</tr>
</tbody>
</table>

Place 0.2 (small rabbit) to 0.5 (large rabbit) cc 2% lidocaine at the back of the rabbit’s throat and wait 10 seconds before proceeding to intubate. You may use a 1-ml syringe (without a needle attached) or instill the lidocaine through the ETT.

**It is important to be gentle when attempting intubation in order to minimize pharyngeal trauma.**
Anesthesia for Healthy Rabbits (Cont’d)

**Technique for blind intubation:**

With the rabbit in lateral recumbency and its head and neck extended, deposit lidocaine at the back of the throat.

After 10 seconds, the ETT is gently advanced to the back of the throat. Observe for condensation within the lumen of the ETT and listen for breath sounds. When the tip of the ETT is directly over the larynx, condensation will appear. Watch the chest movement and try to time advancement of the tip of the ETT with INSPIRATION (when arytenoids will be open widest).

It may be necessary to advance and withdraw the tip of the ETT several times, all the while observing chest movement and looking for condensation within the ETT.

Proper placement in the trachea is confirmed by the appearance of condensation in the clear, see-through wall of the ETT and on a mirrored surface such as the end of the laryngoscope handle. If condensation does not appear, or if signs of airway obstruction develop, withdraw the ETT as you have placed the tube in the esophagus.

If the rabbit swallows, chews or coughs vigorously while you are attempting to intubate, the patient is not sufficiently sedated. Anesthesia needs to be deepened by IV ketamine 0.2 mg/kg or SQ top up of the initial premed at 25% of the initial dose.

**Technique for blind intubation aided by use of a modified stethoscope:**

With the sedated rabbit in lateral recumbency and its neck fully extended, deposit lidocaine at the back of the throat.

After 10 seconds, the ETT is gently advanced to the back of the throat.

Attach the ETT adaptor to the female adaptor on the end of the modified stethoscope and place the stethoscope ear pieces in your ears. The stethoscope will amplify breath sounds at the tip of the ETT and allow you to stand more upright during the intubation process.

Listen for breath sounds. You may need to advance the ETT further into the rabbit’s mouth to begin to hear the breath sounds. When the tip of the ETT is directly over the larynx, condensation will be visible and breath sounds will be audible. Watch the chest movement and try and time advancement of the tip of the ETT with INSPIRATION (when arytenoids will be open widest).

It may be necessary to advance and withdraw the tip of the ETT several times, all the while observing chest movement, listening for sustained breath sounds and looking for condensation within the ETT. If breath sounds become weaker, withdraw the ETT from the esophagus until breath sounds are loud again, indicating you are near the larynx. Then advance again.

When (not if) the breath sounds become very loud, stop ETT advancement and congratulate yourself as you have successfully intubated your patient. Avoid advancing the distal end of the ETT beyond the thoracic inlet. Once you are convinced that the ETT is properly positioned in the trachea, secure the ETT.
Anesthesia for Healthy Rabbits (Cont’d)

If the rabbit swallows, chews or coughs vigorously while you are attempting to intubate, the patient is not sufficiently sedated. Anesthesia needs to be deepened by IV ketamine 0.2 mg/kg or SQ top up of the initial premed at 25% of the initial dose.

**Technique for guide assisted intubation:**

With the rabbit in sternal recumbency, position it as you would a cat for intubation.

Using an otoscope cone or a laryngoscope with a size 00 pediatric blade, visualize the rabbit’s arytenoid cartilages at the opening of the trachea.

Using a 12 inch length cut from a 3.5 french plastic urinary catheter as a guide, advance about 2-3 inches of the guide into the trachea. Remove the otoscope or laryngoscope blade. Then feed the ETT over the urinary catheter without ever letting go of the catheter guide!! Continue to hold onto the guide as the ETT is gently advanced until it is well within the trachea.

Verify proper placement by observing condensation within the ETT, normal respiratory effort and hearing breath sounds within the ETT.

**Technique for placement of the LMA (rabbits over 3 kg):**

With the sedated rabbit in lateral or sternal recumbency, extend its neck fully.

Deflate the cuff of the LMA completely.

With the cuffed opening of the LMA directed sideways (cuff parallel with dental arcade) advance it into the patient’s mouth and behind the base of the tongue using gentle but continuous pressure.

Once you have cleared the base of the tongue, twist the LMA such that its cuffed opening is now pointing caudo-ventrally (parallel with the surface of the tongue) and stop advancing once you encounter resistance.

Using the modified stethoscope attached to the proximal end of the LMA, listen for breath sounds - they should be loud and clear, the rabbit’s breathing should be effortless.

Inflate the cuff of the LMA. If breathing becomes labored or if the tongue becomes cyanotic, reduce the cuff inflation until breathing returns to a normal pattern.

Secure the LMA.

**Confirming proper placement of the ETT or LMA:**

There should be observable excursions of the reservoir bag of the anesthesia machine as the patient breathes.

You may observe condensation within the lumen of the ETT.

You should palpate the rabbit’s throat area and identify only one rigid tube. If your palpation reveals two rigid tubes then you have placed the ETT in the esophagus.

Tube placement in the esophagus is usually associated with obvious signs of upper airway obstruction such as paradoxical breathing and failure of the chest to expand despite obvious respiratory efforts by the patient. However very deeply sedated patients may not manifest these signs of distress.
Anesthesia for Healthy Rabbits (Cont’d)

Intubating with a rigid endoscope:

Desensitize the pharynx/arytenoid cartilages using lidocaine as described above.
Pre-oxygenate the rabbit for 2-3 minutes by face mask.
Thread a rigid 1 mm endoscope through the lumen of the endotracheal tube. With the rabbit in sternal recumbency, advance the tube/scope into the oral cavity over the base of the tongue to the pharynx.
Look for identifiable landmarks such as the arytenoid cartilages (which should be moving with inspiration) as well as the epiglottis. Advance the tube/scope into the trachea. At this point you should be able to identify tracheal rings.
Quickly remove the endoscope from the lumen of the endotracheal tube as its presence will interfere with the patient’s ability to breathe.
Secure the tube in place.

Pain management:

As a prey species, rabbits hide their signs of pain. Palpation of the surgery site as well as observation for movement around the cage are necessary for proper evaluation of discomfort.
For mild to moderate pain: buprenorphine 0.02 mg/kg IM BID or meloxicam 0.3 mg/kg IM SID. Buprenorphine and meloxicam can be combined for moderate to severe pain and can be dispensed for out-patient analgesia: buprenorphine 0.01 mg/kg every 8 hours and meloxicam 0.3 mg/kg every 24 hours for no more than 5 days. Trans oral mucosal buprenorphine may not be effective in all patients. You may need to instruct your clients in how to administer it by SQ injection if pain appears to be poorly controlled.
Canine and feline meloxicam contraindications apply to rabbits (see Meloxicam page 5-31).
Oxymorphone 0.05 mg/kg IM and hydromorphone 0.1 mg /kg IM can be used to control severe pain. Use for longer than 48 hours predisposes to ileus constipation and anorexia.
Anesthesia for Fractious Cats

Pre-anesthesia evaluation:
Rely on history and information obtained from client if physical examination puts you, the owner or any staff members at risk of being injured.

Chest auscultation should be attempted to rule out heart murmurs and arrhythmias. Cats with these abnormalities are poor candidates for the protocols below unless cardiac ultrasound rules out significant heart disease.

Prior administration of oral diazepam 0.5 mg/kg or phenobarbital 10 mg/kg or buprenorphine 0.03 mg/kg at home about 90 minutes before travel to the hospital may permit safe chest auscultation once the patient is admitted to hospital. Once cardiac abnormalities are ruled out, additional IM premedication drugs can be administered if needed for IV catheter placement.

Diagnostic samples and tests are best performed after the patient is chemically restrained. Separate the cat from its owner to ensure client safety and facilitate handling.

Anticipated problems:
- Handling during pre and post-anesthetic period
- Heavy premedication to obtain suitable restraint
- Positional airway obstruction and hypoventilation as heavy premedication takes effect
- Delayed recovery from heavy premedication

Premedication:
The following restraint protocols enable you to remove the cat from a carrier or kennel, wrap it in a blanket, perform a cursory physical exam, place an IV catheter and complete the anesthetic induction with IV drugs. Choose from the following protocols:

- Ketamine 2 mg/kg (maximum 10 mg/cat) + acepromazine 0.05 mg/kg + midazolam 0.2 mg/kg + butorphanol 0.2 mg/kg all together in one syringe IM. Telazol 4 mg/kg can substitute for ketamine and midazolam but will result in longer recovery. Once the patient is restrained, administer IM glycopyrrolate 0.01 mg/kg or atropine 0.02 mg/kg.

- Medetomidine 5 ug/kg (or an equal volume of Dexdomitor + butorphanol 0.2 mg/kg + ketamine 2 mg/kg (maximum 10 mg/cat) + midazolam 0.2 mg/kg all IM in the same syringe.

- Alfaxalone (Alfaxan) 2 mg/kg IM may be used to obtain an initial level of light and brief (under 10 minutes) chemical restraint to facilitate IV catheter placement if you wish to avoid ketamine or alpha 2 based premedication. Once the patient is restrained, administer IM glycopyrrolate 0.01 mg/kg or atropine 0.02 mg/kg.

After 15 minutes, if restraint is insufficient to permit IV catheter placement, administer a dose of 2 mg/kg IM ketamine.
Anesthesia for Fractious Cats (Cont’d)

If safe IM injection is not possible:

1. Draw 1 cc of ketamine into a syringe. Attach a feline urethral catheter to the syringe. Direct the catheter through the cage or travel kennel door toward the cat’s mouth. Extremely fractious cats may chew on the catheter. Quickly inject ketamine into the cat’s mouth.

2. Telazol 4 mg/kg orally can be used as described for ketamine above. Allow 10-15 minutes for above protocols to take effect and keep patient under close observation. If restraint is inadequate, administer IM midazolam 0.5 mg/kg (my favorite). Once the patient is restrained, administer IM glycopyrrolate 0.01 mg/kg or atropine 0.02 mg/kg and flush eyes with saline.

Induction: (see page 3-3)

Choose from among the following:

- IV pentothal (see Pentothal induction page 2-1)
- IV propofol (see Propofol induction page 2-2)
- IV ketamine and diazepam (see Ketamine and diazepam induction page 2-4)
- IV alfaxalone (can be used with alfaxalone premedication see alfaxalone induction page 5-2a)

Titrated IV using small boluses of 10 % of the usual calculated doses.

Maintenance: (see page 3-4)

Inhalation anesthesia via ETT with sevoflurane or isoflurane with or without nitrous oxide.

Monitoring: (see page 3-4):

Carefully monitor depth of anesthesia as inhalant requirements will be dramatically reduced by heavy premedication. Carefully evaluate breathing rate and depth, as heavy premedication will accentuate the respiratory depressant effects of inhalant anesthesia. See Monitoring Depth of Anesthesia page 2-8 for further assistance when using medetomidine based anesthesia protocols.

Support: (see page 3-4)

Assist breathing as needed to counter the respiratory depression induced by heavy premedication.

Special Instructions:

Keep patients under careful observation after premedication. Expect slow recovery due to heavy premedication therefore it is best to schedule these patients for early morning procedures. 100 cc SQ LRS post-anesthesia helps speed up recovery. Provide oxygen supplementation via face mask until the patient can maintain sternal recumbency.
Anesthesia for the Cat with Urethral Obstruction

Anesthesia is intended for urethral obstruction relief and placement of an indwelling urethral catheter. These patients are poor candidates for prolonged anesthesia. No other surgical procedures should be undertaken until electrolyte abnormalities, fluid deficits and azotemia have been resolved.

In severely depressed cats, urethral catheterization can be accomplished with infiltration of 0.5 cc of 2% lidocaine into the urethra. The urethral mucosa will become desensitized in 2 to 3 minutes. Alternatively, in compromised patients urethral catheterization may be performed using caudal epidural analgesia alone or with a light level of IV chemical restraint.

**Patient evaluation: (see page 3-2)**

Evaluate whether the following parameters are mildly moderately or severely affected:

- Hydration
- CNS depression
- Heart rate and rhythm-hyperkalemic cats often have inappropriately normal or low heart rates

Perform lead 2 ECG if hyperkalemia is suspected. Look for the following indicators of hyperkalemia:

- Bradycardia or normal heart rate-cat should be tachycardic
- Peaked or tented T waves
- Depression or loss of P wave
- Prolonged QRS complex
- Heart block
- Sine wave configuration

**Premedication: (see page 3-3)**

If possible place IV catheter without chemical restraint and follow with either:

- Butorphanol 0.1 mg/kg IV + atropine 0.02 mg/kg IM
- Fentanyl 1 ug/kg IV + atropine 0.02 mg/kg IM.

If additional sedation is needed, add midazolam 0.1 mg/kg IV.

If chemical restraint is required for IV catheter placement: 0.2 mg/kg of butorphanol and 0.02 mg/kg of atropine both IM. Add midazolam 0.2 mg/kg if needed. Wait 20 minutes before attempting to place IV catheter.

For light chemical restraint prior to awake caudal epidural analgesia, administer butorphanol 0.2 mg/kg IV or fentanyl 1 ug/kg IV

- OR
- Alfaxan 0.5 mg/kg IV. Also administer atropine 0.02 mg/kg IM.
Anesthesia for the Cat with Urethral Obstruction (Cont’d)

An approach to hyperkalemia in feline urethral obstruction:

If serum potassium can be measured in-house then do so. Regardless of the serum potassium level, hyperkalemia associated bradycardia and ECG changes are contraindications to anesthesia until these changes are reversed.

Hyperkalemic cats will tolerate urethral obstruction relief with little or no chemical restraint and urethral desensitization with lidocaine. Once diuresis is established serum potassium levels will begin to decrease.

Treating hyperkalemia:

To be initiated in cats with ECG changes and that require anesthesia for obstruction relief:

1. Administer dextrose 50% at 1 to 2 mls/kg IV over 5 minutes. If no improvement in the ECG trace is seen in the following 10 minutes, administer regular insulin IV ¼ unit. Monitor blood glucose.

2. If no improvement in the ECG trace is seen in the following 10 minutes, administer sodium bicarbonate slowly IV at 0.5 mEq/kg over 10 minutes.

3. If there is still no improvement in the ECG trace, in the ensuing 5 to 10 minutes, or in the event of asystole, administer 10% calcium gluconate 0.5 to 1.0 ml/kg IV. Response will be seen within 5 minutes but will last less than 20 minutes. This is enough time to relieve the urethral obstruction and promote diuresis. Diuresis is the most effective means of treating hyperkalemia.

CAUTION: Do not mix calcium and sodium bicarbonate solutions.

Induction: (see page 3-3)

IV Alfaxan (see Alfaxan page 5-2a).
IV ketamine and diazepam (see Ketamine and diazepam induction page 2-4).
Deliver oxygen by face mask throughout induction.

Maintenance: (see page 3-4)

Intubate and deliver oxygen supplementation. You may obtain up to 15 minutes of sleep time after induction in a depressed patient. If the obstruction is refractory to rapid catheterization, proceed to inhalant anesthesia with isoflurane or sevoflurane.
Nitrous oxide may be added (see pages 5-38, 2-7).
These are usually depressed patients with reduced dose requirements for inhalant anesthesia.

Support: (see page 3-4)

Start IV fluids after obstruction is relieved unless the patient is in shock and requires pre-anesthesia IV therapy.
Anesthesia for the Cat with Urethral Obstruction (Cont’d)

Support: (cont’d)
Begin aggressive fluid therapy as soon as urethral obstruction is relieved. LRS and Normosol R are acceptable but Plasmalyte 148 is superior. Saline 0.9% supplemented with 30 mEq of sodium bicarbonate/litre can also be used.

Monitoring: (see page 3-4)
Continuous lead II ECG.

Special instructions:
IV dexamethasone NaPO₄ 1 mg may reduce urethral swelling and ease catheterization.
Infusion of 0.5 mls of 2% lidocaine will desensitize the urethral mucosa and lower the dose of anesthetic drugs necessary for urethral catheter placement.
Aggressive post-obstruction IV fluid and electrolyte therapy is required to avoid hypokalemia, hypovolemia and dehydration.
Dehydration from post-obstruction diuresis is a major cause of delayed anesthesia recovery.

Caudal epidural analgesia:
This technique may be used in combination with IV or IM chemical restraint or as an analgesia supplement to general anesthesia. It will provide up to 24 hours of pain relief when bupivacaine or lidocaine are combined with morphine or buprenorphine and delivered epidurally at the sacro-coccygeal space.
For detailed technique see page 6-27a.
Anesthesia for Canine and Feline Ophthalmic Surgery (Cont’d)

Pain control:

Intra-ocular procedures are mildly painful. Repeated doses of powerful opioids such as oxymorphone, hydromorphone, fentanyl and morphine are usually unnecessary and associated with agitation and dysphoria on recovery. To promote smooth recovery, administer acepromazine 0.01 mg/kg ten minutes prior to extubation.

Tramadol and buprenorphine are recommended for feline post-operative analgesia.

NSAIDs and tramadol are recommended for canine post-surgical analgesia.

See page 5-46b for information about the use of rocuronium for neuro-muscular blockade during ophthalmic surgical procedures.
Chemical Restraint for Canine Cardiac Ultrasound

For dogs with suspected heart disease and a history of previous pulmonary edema, syncope or exercise intolerance. Dogs in congestive heart failure may not tolerate any form of chemical restraint.

**IM midazolam 0.2 mg/kg + butorphanol 0.2 mg/kg**
- Ideal for agitated dogs
- Allow 20 minutes of quiet before handling

**IV diazepam 0.1 mg/kg + butorphanol 0.1 mg/kg**
- Allows titration to desired level of sedation and more consistent sedative effects
- More rapid onset than IM delivery

**IV fentanyl 4 ug/kg**

Chemical Restraint for Feline Cardiac Ultrasound

For cats with heart murmur, gallop heart rhythm and/or prior thromboembolic episodes. Cats with pulmonary edema, pleural effusion or thrombi should not receive chemical restraint.

Phenobarbital 10 mg/kg is acceptable as initial chemical restraint in cats that are known to be fractious or combative on prior visits to your facility. However it must be administered orally at home about an hour before planned travel (see Phenobarbital page 5-41a). The chemical restraint options listed below may be administered in addition to the phenobarbital once the patient is admitted to hospital.

**IM midazolam 0.2 mg/kg + butorphanol 0.2 mg/kg**
- Ideal for agitated cats
- Allow 30 minutes of quiet before handling

**IV diazepam 0.1 mg/kg + butorphanol 0.1 mg/kg**
- Allows titration to desired level of sedation and more consistent sedative effects
- More rapid onset than IM delivery

**IV fentanyl 1 ug/kg**

Oral or IV buprenorphine 0.02 mg/kg
Chemical Restraint for Feline Cardiac Ultrasound (Cont’d)

Intramuscular Alfaxalone 2 mg/kg to permit IV catheter placement as well as about 10 minutes of imaging time. If more imaging time is required, additional IV alfaxalone may be administered in increments of 0.5 mg/kg as needed with or without IV butorphanol 0.2 mg/kg IV. Administer I.M. glycopyrrolate 0.01 mg/kg to reduce the accumulation of airway secretions caused by alfaxalone administration.
Patient has Increased Breathing Effort (Cont’d)

Patient at a surgical plane of anesthesia AND increased breathing rate

Yes

Patient is dyspneic

No

Check for failure in oxygen supply

Yes

O₂ ok

No

Check anesthesia machine
- look for causes of hypercarbia +

+ - Depleted absorber granules (circle)
- Canister out of circuit (circle)
- Missing or “stuck” valve in circle (circle)
- Malfunction to Inner hose (Bain)
- Improper oxygen flow rate (Bain)
- Hyperthermia including MH (patient)

* If uncertain whether dyspnoea is inspiratory or expiratory, consider both possibilities
Alfaxalone (alphaxalone) - brand name Alfaxan

Steroid with anesthetic properties (but no steroid effects)

**Beneficial qualities:**
- Minimal hypotension
- Minimal changes in heart rate
- Minimal respiratory depression
- No tissue irritation if administered peri-vascularly
- Suitable as an intramuscular (I.M.) sedative
- Excellent muscle relaxation providing ease of endotracheal intubation

**Undesirable characteristics:**
- Calculated volume may be impractical for I.M. sedation of larger patients (dogs)
- No preservative - contents of opened bottle should be discarded after initial use
- Rough or stormy recovery in the absence of appropriate premedication

**Indications:**
- Induction of anesthesia
- Maintenance of anesthesia
- Chemical restraint/sedation for non-painful manipulations such as diagnostic imaging, IV catheter placement

**Dose recommendations:**
- 2 mg/kg I.M. for chemical restraint or anesthetic premedication
- 1 to 5 mg/kg I.V. for induction of anesthesia
- 0.1 mg/kg/minute for anesthesia maintenance

Respiratory depression is always possible so be vigilant about monitoring your patient.

For more details visit:  [http://www.alfaxan.co.uk/](http://www.alfaxan.co.uk/)
Bupivacaine

Amide local anesthetic.

**Beneficial qualities:**
- Local anesthesia of long duration
- Longer duration than lidocaine or mepivacaine: 3 to 6 hours depending on dose administered

**Undesirable characteristics:**
- Slower onset than lidocaine or mepivacaine: 10 to 20 minutes depending on dose
- More cardio toxic than other local anesthetic agents

**Indications:**
- Tissue or nerve infiltration for local or regional anesthesia

**Relative contraindications:**
- When brief duration of numbness/anesthesia is desired

**Absolute contraindications:**
- Intravenous administration
- Known sensitivity to amide local anesthetic agents

**Recommended dose:**
2 mg/kg maximum cumulative dose for tissue infiltration and specific nerve blocks. There is no advantage or benefit to diluting bupivacaine with lidocaine.
Buprenorphine

Partial Mu receptor agonist opioid analgesic.

**Beneficial qualities:**
- Minimal organ toxicity
- Long duration of effect
- Less histamine release than morphine
- Unlikely to induce dysphoria in cats
- Unlikely to induce hyperthermia in cats
- Does not induce vomiting
- Less respiratory depression than other mu opioids
- Reliably absorbed from oral mucous membranes of cats
- Reduces inhalant anesthetic dose requirements

**Undesirable characteristics:**
- Respiratory depression (mild).
- Analgesic action suitable for control of mild to moderate pain only.
- Relatively slow onset (10 to 15 minutes).
- Possible abnormal behaviour after repeat dosing for 3-4 days when treating acute surgical pain in cats.
- Difficult to reverse.

**Indications:**
- Parenteral and oral trans-mucosal analgesia for control of mild to moderate pain in dogs and cats
- Lumbo sacral and caudal epidural analgesia for forelimb, hind limb, caudal body or abdomen
- Combined with bupivacaine for local nerve blocks to prolong duration of analgesia

**Absolute contraindications:**
- Previous allergic reaction to opioids

**Relative contraindications:**
- When moderate to severe pain is present or anticipated
**Buprenorphine (Cont’d)**

**Dose:**

**Canine dose:** 0.01 to 0.02 mg/kg I.V. or I.M. every 8 hours to 12 hours  
0.02 to 0.03 mg/kg S.Q. or P.O. (trans-mucosal) every 8 hours to 12 hours

**Feline dose:** 0.01 to 0.02 mg/kg I.V. or I.M. every 8 hours to 12 hours  
0.02 to 0.03 mg/kg S.Q. or P.O. (trans-mucosal) every 8 to 12 hours

**Feline:** If administering sustained release formulation: 0.12 mg/kg SC every 72 hours.  
Trans-oral mucosal administration may not provide sufficient analgesia in all patients therefore, it is advisable to initiate pain control with parenteral administration of buprenorphine.

**A note about sustained release buprenorphine:**
- The recommended dose above is considered to have comparable efficacy to 0.02 mg/kg oral trans-mucosal dosing every 12 hours.  
  There is currently no data reported on the incidence of injection site reactions.  
  I do not recommend the use of sustained release buprenorphine in dogs.
Dexmedetomidine

Alpha 2 receptor agonist sedative and analgesic.

**Desirable qualities:**
- Reversible
- Analgesic
- Provides excellent relaxation and sedation even in fractious patients
- Shorter acting than medetomidine at equivalent doses

**Undesirable characteristics:**
- Cardiac depression
- Hypertension
- Occasional vomiting when combined with hydromorphone or morphine
- Occasional esophageal reflux when combined with hydromorphone or morphine and possibly other mu opioid analgesics
- Bradycardia
- Sudden violent response to noise or pain
- Occasional re-sedation after atipamazole reversal

**Indications:**
- Chemical restraint of dogs and cats
- When sedation and analgesia are required
- Anesthetic premedication

**Contraindications:**
- Caesarian section
- Patients with cardiovascular disease, organ dysfunction or severe injury

Dexmedetomidine can be used interchangeably with medetomidine: See pages 5-27 to 5-30 for additional recommendations on their use as part of an anesthetic or chemical restraint protocol. To substitute dexmedetomidine for medetomidine in any of these recommendations, simply use the same volume.

For instance 10 ug/kg medetomidine would be similar in effect to 5 ug/kg dexmedetomidine and the volume of Domitor brand will equal the volume of Dexdomitor brand for the calculated dose.

Expect dexmedetomidine sedation to be of shorter duration than medetomidine. Some clinicians administer slightly higher doses of Dexdomitor when substituting it for Domitor in order to obtain more consistent results. For instance, instead of administering an equivalent volume, they increase the dexmedetomidine volume by 20 to 25%.
Methadone

Mu opioid agonist analgesic.

**Beneficial qualities:**
- Analgesia for moderate to severe pain
- Minimal organ toxicity
- Moderate duration of effect
- Reduced inhalant anesthetic dose requirements when used for premedication

**Undesirable characteristics:**
- Respiratory depression when combined with inhalant anesthesia
- Dysphoria at high doses in non-painful patients
- Bradycardia
- Requires special licensing and record keeping

**Indications:**
- Oral or parenteral analgesia for moderate to severe acute or chronic pain
- Pre-anesthetic sedation either alone or in combination with acepromazine, medetomidine or dexmedetomidine

**Absolute contraindications:**
- Previous allergic reaction to opioids

**Relative contraindications:**
- CNS disease
- Respiratory distress
- Neuromuscular disease

**Dose:**
Dogs and cats: 0.22 to 0.5 mg/kg every 6 to 12 hours I.M., I.V., S.Q. or orally
Phenobarbital

Barbiturate with intermediate duration of action, discussed here as an oral adjunct to premedication in fractious or anxious patients.

**Beneficial characteristics:**
- Good oral absorption
- Reliable mild chemical restraint
- Can be combined with other pre anesthetic and anesthetic drugs administered parenterally

**Undesirable properties:**
- Long acting
- Large dose range making initial dose requirement difficult to predict
- Controlled substance

**Indications:**
Pre anesthesia oral medication for extremely anxious or fractious dogs and cats.

**Relative contraindications:**
When rapid onset or brief duration of action is required.

**Absolute contraindications:**
- Pre-existing CNS depression

**Dose:** 5 to 20 mg/kg orally at least 60 minutes prior to travel to hospital facility.
Propoflo 28

Brand name of phenol hypnotic anesthetic agent containing the preservative benzyl alcohol in a 2% concentration.
Licensed for use in dogs only.

Beneficial characteristics:
- Same as for propofol
- Shelf life of 28 days at room temperature once opened

Undesirable effects:
- As for propofol
- Potential for benzyl alcohol toxicity in cats if administered at high doses

Indications:
- IV anesthetic induction
- IV anesthetic maintenance - for dogs only (including sight hounds)

Absolute contraindications:
- As for propofol
- Delivered by constant rate infusion to cats for sedation or maintenance of anesthesia

Relative contraindications:
- Same as for propofol

Dose:
5 mg/kg IV (see pages 2-2, 2-3).

This dose is safe for anesthesia induction of cats. Excessive and potentially toxic doses of the benzyl alcohol preservative may be delivered if Propoflo 28 is administered to cats as a constant rate infusion.
Rocuronium

Non-depolarizing muscle relaxant.

**Beneficial characteristics:**
- Causes complete immobilization with maximum muscle relaxation
- Intermediate duration of action
- Reversible
- More rapid onset of paralysis than equipotent doses of atracurium.
- More rapid recovery of normal Train-of-Four twitch response.

**Undesirable properties:**
- Respiratory paralysis necessitating IPPV
- Histamine release-mild and rare

**Indications:**
- Immobilization of the eye for intra-ocular procedures
- Relaxation of skeletal muscles to facilitate orthopedic procedures
- As part of a balanced anesthesia technique

**Contraindications:**
- Inability to provide IPPV
- No access to either neostigmine or edrophonium reversal agents

**Dose:**
0.4 to 0.6 mg/kg IV by titration as needed to abolish the Train-of-Four response from a nerve stimulator provides 15 to 30 minutes of complete paralysis. Multiple top up dose of 0.16 mg/kg will each provide 10 to 20 minutes of additional duration of paralysis (*See pages 3-107, 3-110*).
Sacro-coccygeal Epidural Analgesia in the Dog and Cat

**Patient selection:**
Use with heavy sedation for minimally invasive caudal surgery such as tail dock.
Use with light sedation in compromised cats requiring urethral catheter placement for obstruction relief.
Use to supplement analgesia during general anesthesia for perineal procedures.

**Contraindications:**
- Coagulopathy
- Sepsis
- Neurological impairment
- Pyoderma in sacro-coccygeal area

**Patient restraint and handling:**
Perform the block after induction of general anesthesia and intubation or after effective sedation.
Severely compromised patients may not require any form of chemical restraint.

**Patient positioning:**
Sternal recumbency.

**Anatomical landmarks:**
The sacro-coccygeal intervertebral space can be identified by moving the patient’s tail up and down. The sacro-coccygeal space is between the mobile tail and the immobile sacrum.

**Materials:**
- Sterile 3cc syringe
- Sterile single use vial of preservative free morphine or buprenorphine. (In Canada, preservative containing morphine can be selected as the preservative is sodium metabisulfite)
- Sterile single use vial of preservative free lidocaine or bupivacaine
- Sterile gloves
- Disinfectant supplies for surgical preparation of the skin
- A 5/8 inch or 1 inch 25 gauge single use hypodermic needle
Sacro-coccygeal Epidural Analgesia in the Dog and Cat (Cont’d)

Injection technique:
1. Assemble all the necessary materials.
2. Aseptically prepare the skin in the sacro-coccygeal area. Shave only sufficient fur to allow aseptic injection as hair re-growth is occasionally delayed. In long haired breeds, clip the fur in a way that allows camouflage of the shaved area.
3. Draw up anesthetic agents. Local anesthetic drugs and opioids can be combined in the same syringe:
   2% lidocaine 2 mg/kg OR 0.5% bupivacaine 0.5 mg/kg combined with morphine 0.1 mg/kg OR buprenorphine 3 to 5 ug/kg.
4. Wearing sterile gloves, identify the sacro-coccygeal intervertebral space by moving the patient’s tail up and down. The sacro-coccygeal space is between the mobile tail and the immobile sacrum. If you are right handed, perform this task with your left hand and vice versa.
5. Insert a 25 gauge 5/8 inch hypodermic needle through the skin at the midline with the needle at a 45 degree angle to the skin surface. Aim the needle’s bevel cranially. Unlike spinal needles, hypodermic needles do not allow you to identify the bevel direction once the needle tip is buried so you must make note of the bevel direction before advancing the needle through the skin.
6. After penetrating through the skin, the needle will face only slight resistance until it encounters the intervertebral ligament. A discernible “pop” may be appreciated as the needle is advanced to the floor of the sacrum which will feel like a bony structure. Once the bony structure has been encountered, stop any further advancement of the needle.
7. To verify needle placement:
   - The needle should be buried deep enough to be through the skin and SQ tissues without encountering bone.
   - Connect a syringe to the needle and aspirate to confirm the absence of blood.
8. Inject anesthetic agent over 10 seconds using steady pressure. You should not encounter any resistance to injection. If you do, try repositioning by pulling the needle out slightly.

Within 5 minutes, the onset of tail flaccidity should be detectable. The block can be attempted a second time using the initial drug doses if there is failure on the first attempt.

Use of epidural lidocaine will provide at least 60 minutes of perineal desensitization and use of epidural bupivacaine will provide at least 3 hours of numbness. The epidural opioid provides 18 to 24 hours of additional analgesia after tail motor tone and sensation have returned. This regional block does not affect hind limb motor or sensory function.