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ENDOCRINE & ANESTHESIA PROTOCOLS: AN EXCLUSIVE SERIES

This series focuses on anesthesia considerations for dogs and cats with thyroid, parathyroid, adrenal, and pancreatic diseases. Additional details pertaining to pathophysiology and diagnosis are also discussed.[1-3] In this issue, an anesthesia protocol for patients with thyroid gland disease is recommended, although it is only one approach and specific cases may require varied methodology.

Anesthesia for Thyroid Gland Disease

You have asked…

What is the best approach for anesthetizing patients with thyroid gland disease?

The expert explains…

WHAT IS THE SUGGESTED PROTOCOL FOR PATIENTS WITH HYPOTHYROIDISM?

Hypothyroidism is recognized commonly in dogs; in cats, hypothyroidism is usually iatrogenic (secondary to treatment of hyperthyroidism). In addition to the common clinical picture of hypothyroidism (dull hair coat, hair loss, mental dullness, weight gain), additional conditions may influence anesthetic management, such as laryngeal paralysis and megaesophagus. Laboratory findings typically include hypercholesterolemia, and nonregenerative, normochromic, normocytic anemia may be diagnosed in up to 40% of patients. Many tests (total and free T_4, TSH stimulation, T_3, reverse T_3, TRH response) are available for evaluating thyroid function and may be used to confirm diagnosis based on clinical and initial (routine) laboratory findings.

Anesthesia Considerations & Management

Anesthesia selection and maintenance depend on disease severity. Patients rendered euthyroid with thyroid supplementation require no special drugs, so a routine anesthesia protocol is sufficient. Unregulated patients or those with clinical or laboratory signs of disease have higher anesthetic risk. For example, animals with clinical signs of disease may have decreased anesthetic requirements; however, they more frequently have prolonged anesthetic recoveries. This results from the decreased metabolic rate and body temperature, which may slow clearance of anesthetic drugs. In addition, patients are more susceptible to anesthetic-induced hypotension because of a hypodynamic cardiovascular system (decreased stroke volume and heart rate), baroreceptor dysfunction, and β-adrenergic receptor down-regulation, and they often do not respond to therapy as a normal patient might.[4,5]

CONTINUES

Animals with clinical signs of disease may have lower anesthetic requirements but they also have prolonged anesthetic recoveries.

Fast Facts

- Diazepam can help reduce the ketamine dose and may be reversed as necessary.
- In hyperthyroid patients, the most significant risk pertaining to anesthesia results from cardiac changes.

Anesthetic Plan for Uncomplicated Hypothyroidism

Premedication

Sedation may not be necessary in every case. Opioids with a short (eg, fentanyl 5–10 µg/kg SC or 1–3 µg/kg IV) to moderate (eg, hydromorphone 0.05–0.1 mg/kg SC or 0.01–0.02 mg/kg IV) duration of action are suggested, as they are both cardiovascularly safe and reversible and will provide periprocedural analgesia and mild to moderate dose-dependent sedation. At the attending veterinarian's discretion, an anticholinergic (eg, atropine 0.02–0.04 mg/kg SC or 0.01–0.02 mg/kg IV) can be added, as many of these patients have slow heart rates that may influence cardiac ouput.

Induction

Propofol can be used, but an induction technique that uses ketamine (5 mg/kg, titrated IV) and diazepam (0.25 mg/kg IV) can help support cardiovascular function through indirect sympathetic stimulation. Diazepam can help reduce the ketamine dose (and minimize adverse behavior during recovery, which can be seen with high doses) and may be reversed as necessary. If the veterinarian prefers to use propofol, opioid medication and concurrent use of benzodiazepine to reduce the dose and possible hypotension are suggested. A fluid bolus before induction may also be warranted.

Maintenance

The inhaled agent (eg, isoflurane, sevoflurane) should be dosed to effect.

Periprocedural Analgesics

Analgesics depend on the procedure; mu-opioid agonists are commonly used to provide periprocedural analgesia.

Support & Monitoring

Heart rate may be monitored with a number of devices (eg, stethoscope, pulse oximeter, Doppler) but ECG will allow detection of rhythm changes and is strongly recommended. Blood pressure should also be monitored, as these patients are prone to hypotension, and sympathomimetic support should be available (ephedrine [0.025–0.1 mg/kg IV], dopamine [5 µg/kg/min IV by infusion]). A balanced electrolyte solution should be administered IV. Supplemental glucose may be necessary in some patients. Body temperature should be monitored and supported, keeping in mind that hypothermia is common in hypothyroid patients.

Recovery

Because patients may be susceptible to prolonged recoveries, monitoring and support should be continued into this phase.

Q WHAT IS THE SUGGESTED PROTOCOL FOR PATIENTS WITH HYPERTHYROIDISM?

Hyperthyroidism is more commonly recognized in middle-aged to older cats and has no apparent sex predilection. Dogs are occasionally diagnosed with thyroid tumors, but these are usually nonfunctional. In patients with functional tumors, measurable increases in circulating thyroid hormones can result in multisystemic disease.

The most common presenting complaints and clinical signs associated with feline hyperthyroidism include weight loss and a palpable thyroid gland.[6] Owners may also report vomiting, diarrhea, and changes in appetite and water intake. On examination cats are often thin, show cardiac changes (heart murmur, tachycardia, gallop rhythm), may be aggressive, and look unkempt. The most commonly reported laboratory changes associated with thyroid disease include elevations in liver enzymes and erythrocytosis.[6] Available tests to confirm diagnosis are as previously described for hypothyroidism.

Anesthesia Considerations & Management

Cats with hyperthyroidism are generally older and, in addition to changes caused by the elevation in thyroid hormone concentrations, may have concurrent disease.

The most significant risk pertaining to anesthesia results from cardiac changes in hyperthyroid patients. In addition to tachycardia, murmurs, and a gallop rhythm, many of these patients develop hypertrophy of the left ventricle, predisposing them to myocardial hypoxia, dysrhyth-

mias, and cardiac arrest. Pleural effusion and pulmonary edema may be seen secondary to cardiac disease. Nonspecific changes in hepatic enzymes and azotemia are reported in up to 40% of these patients.

In human patients, hyperthyroidism is thought to mask renal disease because of increased renal blood flow and glomerular filtration. The recommendation in cats showing even mild laboratory changes is to support renal perfusion during the perianesthetic period. This can be especially challenging in cats that are aggressive or unwilling to be handled.

A recommended alternative for nonemergent procedures is to medically treat the patients to render them euthyroid before anesthesia. Antihypertensive drugs may be administered to help reduce cardiac changes if hypertension is part of the clinical presentation.

Anesthetic Plan for Hyperthyroid Cats

Premedication

In cats, an SC opioid is suggested for its cardiovascular safety and analgesia. Although hydromorphone (0.025–0.05 mg/kg SC) can be used safely and effectively, some veterinarians may prefer oxymorphone (0.025–0.05 mg/kg SC) or methadone (0.3–0.5 mg/kg SC).

Keep in mind, however, that even at appropriate doses, opioids do not typically sedate cats but create a sense of well-being or euphoria. Thus, there is a temptation to administer sedatives, such as α_2-agonists (eg, medetomidine, dexmedetomidine), especially in aggressive cats. While this may be acceptable for short-term sedation in cats with hypertrophic cardiomyopathy,[7] negative cardiovascular effects have been reported even in healthy cats undergoing general anesthesia.[8]

As an alternative, a combination of an SC opioid (see above), SC midazolam (0.1–0.2 mg/kg), and very low-dose (2 mg/kg) SC ketamine can be used to sedate fractious cats. Higher doses of IV ketamine are not recommended due to the potential to increase the heart rate and myocardial work load. Similarly, anticholinergics (eg, atropine) are not routinely used in these patients.

Induction

Placement of ECG and Doppler equipment prior to induction is ideal. ECG detects rhythm abnormalities, and Doppler assesses blood pressure changes and provides an audible pulse signal during this critical time.

Preoxygenation is recommended before IV administration of etomidate (0.5–1.5 mg/kg) and a benzodiazepine (diazepam or midazolam, 0.1–0.3 mg/kg). This combination is cardiovascularly safe, but etomidate has the potential to cause adrenocortical suppression, warranting supplementation with physiological doses of steroids in some patients. In addition, in its US preparation (in propylene glycol), etomidate is hyperosmolar and may result in other side effects such as hemolysis and myoclonus. (Note: Propofol should be used judiciously for induction, as vasodilation and subsequent hypotension can influence vital organ perfusion and decrease preload to the heart.) Benzodiazepines facilitate muscle relaxation and improve conditions for intubation.

In fractious patients, chamber inductions with an inhalation anesthetic (to the point of being able to handle the cat) following premedication have been used. While this scenario is not ideal because sympathetic stimulation may exacerbate arrhythmias, stress may be minimized by premedication and acclimation to the chamber. Once a catheter and monitoring equipment have been placed, induction may be completed using the previously mentioned IV drugs.

Maintenance

An inhaled agent is recommended. An opioid infusion (eg, fentanyl 5–10 µg/kg/hr) may be used concurrently to facilitate reduction in the inhaled agent dose to improve cardiovascular performance.

Periprocedural Analgesics

Analgesics are dependent on the procedure; opioids as suggested previously are commonly used, especially for surgical interventions.

CONTINUES

Support & Monitoring
Heart rate, rhythm, and blood pressure should be monitored because hypertensive cats are prone to arrhythmias and hypotension. Sympathetically mediated dysrhythmias (eg, premature ventricular contractions, supraventricular tachycardia) are ideally treated with a short-acting β-blocker, such as esmolol (50 µg/kg/min). Because of its short-acting nature and because lidocaine can have dose-associated toxicity, esmolol tends to be used to treat tachydysrhythmias in cats during anesthesia. As an alternative, propranolol may be carefully administered.

A balanced electrolyte solution should be administered IV with goal of maintaining cardiac filling without overloading the heart. While results of a recent study[9] suggest that inotropes may be used for treatment of hypotension in these patients, it has been our clinical experience at Colorado State University that arrhythmias are more common in patients with dopamine or dobutamine use. The author's preference is thus to use vasopressors such as phenylephrine.

While vasoconstrictors are not typically used for treating anesthesia-induced hypotension, in this circumstance the β-agonists may carry more risk for the patient because of the increased myocardial work load and oxygen consumption. In addition, with hypertrophic cardiac disease, much of the increased afterload is cardiac in origin and low doses of phenylephrine do not appear to exacerbate this but serve to increase preload (venoconstriction) and blood pressure to maintain vital organ perfusion.

In patients with renal compromise, fluids should be administered before, during, and after anesthesia. In addition, fenoldopam (not fully evaluated for efficacy) or low-dose mannitol (0.1 g/kg/hr IV) may be administered. Mannitol is a diuretic that also has free radical-scavenging properties and helps maintain renal perfusion. It is believed to provide renal protection, especially in the face of hypoxia, which could occur during general anesthesia.

Body temperature should be monitored in all cats undergoing general anesthesia. Pulse oximetry and capnography may also be used but with the caveat that when using a nonrebreathing system, the capnograph may significantly underestimate arterial CO_2 tension.

Recovery
A quiet, stress-free environment is ideal. Fluids should be continued in patients with renal compromise and analgesics provided as needed. Oxygen should be provided at least until extubation of the patient but may be helpful until full recovery.

Additional Considerations

In patients undergoing thyroidectomy, additional considerations are warranted. It is suggested that the endotracheal tube (with a Murphy eye) be placed with the tip distal to the surgical site to minimize the chance for occlusion. Clinical signs of anesthesia depth are difficult to monitor after the patient has been draped for surgery.

Perioperative complications include hemorrhage, hematoma formation, airway obstruction, hypoparathyroidism, Horner syndrome, and vocal cord paralysis.

See **Aids & Resources**, back page, for references & suggested reading.

Take-Home Points

- Patients with clinical signs of hypothyroidism may have lower anesthetic requirements and may also have prolonged anesthetic recoveries.
- Body temperature must be monitored, especially since hypothermia is common in hypothyroid patients.
- In hyperthyroid patients, the most significant anesthesia risks result from cardiac changes.
- In patients with renal compromise, fluids should be administered before, during, and after anesthesia.

FIND MORE...

Look for the next installment of this series in a future issue: **Anethesia for Parathyroid Gland Disease**.