There are many common diseases in veterinary medicine that can affect the anesthetic protocol you choose for your patient. A complete history is vital in discovering if your patient has been diagnosed with or is being treated for an underlying disease.

**Cardiac Disease**
There is no one magic bullet recipe for all patients with cardiac disease. You always need to tailor your protocol for each patient. The goal is to minimize cardiovascular changes and keep the workload to a minimum. Sometimes it can be safer to choose drugs you are familiar with instead of the optimum protocol. You know what reactions to expect with familiar drugs but you still do not want to choose the same protocol for every case at the expense of your patient’s safety. First you need to know what disease your patient has and how that will affect the heart. Some general guidelines are to avoid tachycardia, bradycardia, hypovolemia and volume overload. Pre-oxygenating for 5-7 minutes prior to induction is ideal but not if it stresses out your patient and causes an increased heart rate. Anticholinergics (ex. atropine and glycopyrrolate) and dissociative agents (ex. ketamine and Telazol) should be used with caution because they can cause tachycardia. Alpha 2-agonists (ex. xylazine and medetomidine) should be avoided as they are prone to causing severe bradycardia, dysrhythmias and heart block.

Heart murmurs are often noted in the medical record but what does that mean? For these patients pre-anesthetic workup should include thoracic radiographs and echocardiogram. The management of valvular disease can vary greatly depending on which valves are affected. Anticholinergics may be used to treat bradycardia but should not necessarily be a part of a “routine” pre-anesthetic. In stable patients induction may be accomplished with ketamine and diazepam or propofol. In the less stable patient you may choose to use an opioid and benzodiazepine combination (ex. Fentanyl and midazolam) or etomidate. Use conservative fluid therapy but monitor blood pressure if possible to assure adequate perfusion.

Hypertrophic cardiomyopathy (HCM) is the most common cardiac disease of cats. The bad side of HCM is that many times it is not diagnosed and sudden death can occur with the stress of anesthesia, surgery, hospitalization or even restraint. Less is definitely better with these patients. Quick induction with propofol, etomidate or an opioid/tranquilizer combination can be beneficial. If you feel the need to use mask induction, Sevoflurane may be preferred over Isoflurane as the pungent smell of the Isoflurane can be stressful.
Useful anesthetic drugs for patients with cardiac disease

- Diazepam or midazolam 0.2-.04mg/kg IV, IM
- Butorphanol 0.2-0.8mg/kg SC, IV, IM
- Oxymorphone 0.05-0.1mg/kg IV, IM
- Hydromorphone 0.1-0.2 mg/kg IV(lower dose) or IM (higher dose)
- Buprenorphine 0.05-0.1mg/kg IV, IM
- Morphine 0.5-1mg/kg IM
- Propofol 1-6mg/kg IV (lower dose with more potent pre-anesthetic)
- Etomidate 1-2mg/kg IV no more than 2 doses
- Ketamine-diazepam 1ml of 50:50 mixture per 20 lbs, IV
- Ketamine 2-5mg/kg IM, after
- Ketamine-diazepam in cats

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Respiratory Disease

There are many common respiratory diseases that are seen in veterinary practice. Some may be seen during a routine visit such as collapsing trachea or laryngeal paralysis. Others may be seen on an emergency basis such as airway obstruction, pneumonia or pneumothorax. As always we need to assess each patient individually and measure the risks. Some patients will require immediate attention while others will need medical care to improve their status. Low stress for your patient is vital to a good outcome. Imagine the laryngeal paralysis dog that is having difficulty breathing. Imagine YOU were having difficulty breathing….AND you were somewhere that didn’t speak English…..AND you didn’t understand they were trying to help you….AND they were restraining you so you were panicked and had even more trouble breathing. Keep calm, speak in a soothing voice, and use sedation when necessary. With any respiratory problem always have oxygen available even pre and post operatively. Have endotracheal tubes ready in a variety of sizes, a laryngoscope, pulse oximeter and extra personnel available to hand ventilate if necessary. Remember that many brachycephalic breeds have narrow tracheas. A 60 pound English Bulldog may only be able to be intubated with a 6mm endotracheal tube!

Induction should be accomplished quickly with rapid intubation. Good choices for induction are quick acting drugs such as propofol, thiopental, or ketamine/valium. Poor induction agent choices include mask induction, nitrous oxide, and etomidate. Atropine and glycopyrrolate can increase the thickness of airway secretions so use caution with these drugs as pre-anesthetic agents.

During anesthesia be sure that the patient is ventilating properly. If you don’t have capnometry it may be best to have someone assigned to ventilating the patient or monitoring oxygenation. During recovery be sure to keep the stress level low using sedation as needed. Brachycephalic breeds must be monitored closely during the recovery period. Wait to extubate patients of these breeds until they will not tolerate the endotracheal tube being left in. Watch for secretions in the endotracheal tube that can
block the airway. If possible position patients in sternal recumbancy so that both the left and right side of the lungs can fully ventilate. Lateral recumbancy as well as bandages that are placed too tightly can interfere with adequate ventilation.

Liver Disease
The effect a drug has on hepatic blood flow plays a large part in choosing an anesthesia protocol for patients with liver disease. Anesthetic drugs can affect hepatic blood flow by changing vascular tone in the portal vein, the hepatic artery or both. Decreased blood flow can mean decreased hepatic elimination of drugs. In the surgical setting, hypothermia and hypotension will also slow metabolism of anesthetic drugs. Hypothermia can be easily managed with forced warm air blankets or warm water blankets. Blood pressure should be monitored to note decreasing trends in pressure and institute treatment.

Tranquilizers such as acepromazine and the alpha-2 agonists should be avoided because they cause vasodilation and therefore a drop in blood pressure. Acepromazine is metabolized in the liver and may exacerbate coagulopathies. Xylazine and detomidine can cause dysrhythmias such as bradycardia and AV block.

Benzodiazepines such as diazepam (valium) can be used in patients with liver disease but lower than normal doses should be used or profound sedation may occur. Intravenous doses of less than 0.2mg/kg are generally safe but if liver disease is severe the effects may be prolonged. Cats may be more susceptible than dogs to the negative side effects of benzodiazepines.

Dissociative agents such as Telazol or ketamine are acceptable for induction of patients with liver disease as long as smaller intravenous dosages are used. Minimal dosages to allow intubation are preferred. Remember that these agents may also induce seizures.

Propofol is an acceptable agent for induction of anesthesia in patients with liver disease. It has a rapid rate of elimination and excreted 90% by the kidneys. It can cause vasodilation and hypotension, but if used as an induction agent only these quickly pass. Etomidate is also an acceptable agent for induction. It does not decrease hepatic perfusion and has a short duration of action.

Isoflurane and Sevoflurane are the best choices for anesthesia maintenance in patients with liver disease. Halothane is not recommended however because it decreases hepatic blood flow and is metabolized up to 20% in the liver. Isoflurane and Sevoflurane demonstrate good hepatic blood flow at concentrations less than 2 MAC.

Opioids such as morphine, hydromorphone and Fentanyl may be used in these patients. Careful monitoring of respiratory depression and bradycardia is required. Reduced cardiac output from bradycardia can easily be corrected with the administration of an anticholinergic. Buprenorphine and butorphanol are in the opioid family and may cause less side effects but are only acceptable options for mild pain and discomfort.
Renal Disease
No single test gives us a clear picture of renal function. A 70-75% decrease in kidney function must be present before abnormalities are noted in serum chemistries. In older patients, even if renal values are not increased, there most likely is some degree of renal compromise. It is important to correct underlying metabolic and electrolyte abnormalities before initiating anesthesia. Dehydration, azotemia, hyperkalemia, hypocalcemia and anemia are all common findings in patients with chronic or acute renal insufficiency.
You must consider how your anesthesia will affect renal function. Many anesthetic agents cause vasodilation which can lower blood pressure. The mean arterial blood pressure (MAP) should be maintained above 70-80 mmHg to assure adequate renal perfusion. Neonates and pediatric patients do not fall within this range. MAP increases with age and does not approach adult values in dogs until 6-9 months of age. The target is 80% of their values when awake.
Using intravenous fluids during anesthesia is a must. Fluid rates of 20ml/kg for the first hour then 10ml/kg/hour thereafter can be instituted. If the patient has cardiovascular disease the rate should be lowered to avoid an excessive workload for the heart.
Now you need to think about how renal function will affect your anesthetic choices. Acceptable choices for patients with mild renal insufficiency would be propofol, etomidate, low dose ketamine-diazepam, or an opioid-diazepam combination. Maintain anesthesia with Isoflurane or Sevoflurane gas. The use of non-steroidal anti-inflammatory drugs (NSAIDS) should be avoided.

Endocrine Disease
There are several common diseases connected to the endocrine system that will be encountered in veterinary medicine. The key to a successful anesthetic outcome is knowledge of the presenting disease as well as potential complications. Preventing or being prepared for such complications can be the difference between life and death for the patient. Some of the common endocrine diseases in veterinary medicine include diabetes mellitus, insulinoma, hyperadrenocorticism (Cushing’s), hypoadrenocorticism (Addison’s), hyperthyroidism and hypothyroidism. There is no one “silver bullet” anesthesia recommendation that will work for everything. Being familiar with the anesthesia drugs and how they work is the first step towards successfully anesthetizing a patient with endocrine disease. Evaluate every patient to determine the best protocol for that individual. The goal is to return these patients to their normal routines as quickly as possible so using drugs that are quickly eliminated or easily antagonized is the best plan of action.
Diabetes Mellitus
Diabetes is caused by a deficiency of insulin. There are two types of diabetic patients that may be presented for anesthesia: The unregulated, unstable diabetic or the regulated diabetic patient. Performing anesthesia on an unstable diabetic patient should be avoided unless the patient’s life is in immediate danger. A preoperative CBC, chemistry profile and urinalysis should be performed. A resting glucose of greater than 250mg/dL with ketones present in the urine is diagnostic for diabetes. On urinalysis the presence of glucose and ketones is diagnostic. Patients should be stabilized, ketoacidosis corrected,
and ideally regulated prior to anesthesia. For regulated diabetic patients, asking how long the patient has been diabetic, how well it is controlled, whether there are co-existing diseases going on and whether current medications are being administered as well as any nutritional supplements. The well-regulated patient is much easier to manage during and after an anesthetic episode. The goal in the diabetic patient is to keep the anesthesia and recovery time as short as possible so the patient may begin eating again. A common plan is to have the patient fasted overnight and have the owner give half dose insulin in the morning prior to arriving at the hospital. Cats that are on oral glipizide should not receive medication the morning of surgery. The surgical procedure should be scheduled first in the morning. Blood glucose levels should be monitored preoperatively, perioperatively and postoperatively. The goal is to maintain the blood glucose level between 150-250mg/dL. Dextrose may need to be added to IV fluids to maintain this level. Most times 2.5 or 5% dextrose concentrations are used. Remember not to draw the blood glucose sample from the IV catheter that fluids are being administered through as this will result in abnormally high and inaccurate readings. Feeding should be resumed as soon as possible after recovery from anesthesia. Ideally the routine insulin dosing and feeding schedule should be resumed the day after surgery. Due to increased susceptibility to infection of the diabetic patient, aseptic technique is extremely important. Clean hands, aseptic catheter placement and maintenance, sterilized endotracheal tubes and keeping incisions clean and dry are essential.

**Insulinoma**

An insulinoma is a tumor of the pancreas that results in excess insulin production leading to hypoglycemia. Signs of hypoglycemia can include drooling, lethargy, anxiety, ataxia, vocalization, muscle tremors, coma or seizures which can lead to death. Insulinoma most commonly occurs in middle-aged dogs with surgery being the treatment of choice. Like diabetic patients, close monitoring of blood glucose levels is extremely important. Pre-operative workup should include CBC, serum chemistries, chest radiographs and abdominal ultrasound if available. Fasting time should be reduced to 8 hours before surgery. If 24 hour care is available the patient may be admitted to the hospital the night prior to surgery. An IV catheter can be placed to administer maintenance fluids with the addition of dextrose if indicated by blood glucose readings less than 70mg/dL. Blood glucose readings can be taken every 30-60 minutes while the patient is under anesthesia. Remember not to draw blood glucose samples from the IV catheter that fluids are being administered through. If patients are on medical management such as prednisone or diazoxide, those medications may be continued until induction. The goal before, during and after anesthesia is to maintain a normal blood glucose level. Hospitalization and surgery can lead to a couple of situations that need to be monitored. Stress, such as the stress of being hospitalized in an unfamiliar environment and being handled by strangers can increase the release of insulin leading to a hypoglycemic episode. During surgery the handling of the tumor itself can cause massive insulin release resulting in severe hypoglycemia. It is not uncommon for patients to have pancreatitis postoperatively. Pancreatitis patients are maintained NPO therefore fluid therapy with the addition of dextrose can be necessary for 48-72 hours postoperatively. A constant rate infusion of dextrose is more effective at managing hypoglycemia than a bolus injection of dextrose. A large bolus of dextrose will temporarily correct the hypoglycemia but will then
stimulate further insulin secretion leading to a rebound episode of hypoglycemia. Avoid the alpha2 agonists in these patients as well as ketamine and Telazol.

**Hyperadrenalcorticism-Cushing’s Disease**

Hyperadrenocorticism, also known as Cushing’s disease is caused by a chronic overproduction of adrenal steroids or cortisol in the body. Dogs are more commonly affected than cats. When taking a history patient symptoms may include polyuria, polydypsia, excessive bruising, panting, exercise intolerance, muscle atrophy, lethargy, weakness and the classic “pot bellied” appearance. In addition to the symptoms above signs noted on physical examination can include thin skin, bilateral hair loss, hepatomegaly, and hypertension. Cats may present with thin, fragile skin that tears easily. Cushing’s patients commonly also have diabetes. Cortisol antagonizes the actions of insulin leading to a steroid induced diabetes mellitus. The list of potential complications can be daunting, but having the knowledge of what to watch for and being prepared for potential complications will help aid in a successful anesthetic outcome. Hyperglycemia or hypoglycemia can occur with concurrent diabetes. Respiratory compromise can occur for many reasons. Hepatomegaly or an enlarged liver, takes up more space in the abdomen and can press against the diaphragm compressing the thoracic cavity. Muscle weakness can affect the diaphragm making ventilation more difficult for the patient. Obesity adds to the difficulties associated with both hepatomegaly and muscle weakness. The use of capnometry can assist in monitoring ventilation. Hypertension is common due to cortisol’s enhancement of epinephrine’s vasoconstrictive effect. Hypertension may exacerbate an underlying or unknown cardiac condition. Preoperative workup should include CBC, chemistry profile and electrolytes. Clinical signs may also warrant cardiac assessment that includes chest radiographs, ECG, echocardiogram and blood pressure. The anesthetic plan will depend on the status of the patient including cardiac function as well as the planned surgical procedure. Corticosteroid supplementation for Cushing’s patients during stressful situations is vitally important. Dexamethasone is commonly the steroid of choice for use immediately prior to surgery and for 24-48 hours following surgery. Because these patients have polyuria and polydypsia water should be available until the time they receive premedication. When placing an IV catheter, care should be taken to decrease trauma as these patients bruise easily. Aseptic technique from IV catheter placement through post operative care is critical as patients are prone to delayed healing and infection of incisions. If a patient has cardiac compromise, avoid atropine in the pre-anesthetic plan as well as alpha 2 agonists. For induction avoid ketamine as well as thiobarbiturates in cardiac patients as these drugs can increase cardiac workload. Propofol can be a good option although it causes dose dependant hypotension so adequate premedication drugs should accompany it. Etomidate should be avoided if an ACTH test is to be run because it can invalidate the test results. Pre-oxygenation is beneficial for the obese patients with a pot bellied appearance to help ventilatory compromise. Gas anesthesia should be maintained with isoflurane or sevoflurane. Halothane gas should be avoided as it is commonly associated with arrhythmias.

**Hypoadrenalcorticism-Addison’s Disease**

Hypoadrenocorticism, also known as Addison’s disease, stems from a deficiency of glucocorticoid and/or mineralocorticoid secretion. The signs of this disease can be vague at first and can mimic many other more common diseases. It occurs most commonly in young to middle age dogs and rarely in cats. While taking a history, owners may
describe waxing and waning that has occurred over weeks or months. Other symptoms include weakness, depression, dehydration, abdominal discomfort and melena. Dogs presenting in an acute crisis are common. Life threatening clinical signs may include weak pulses, hypothermia, hypotension, hyperkalemia, and hyperkalemia induced bradycardia. Anesthesia should be avoided in unmanaged patients as cardiovascular collapse is possible.

Preoperative workup should include serum chemistries, blood gases, ECG and blood pressure. Be sure to correct hypovolemia and electrolyte imbalances prior to anesthesia. Steroid replacement should be started prior to induction of anesthesia and may be repeated every 2-4 hours perioperatively. For the patient that is stable on mineralocorticoid and glucocorticoid therapy, the anesthetic protocol depends on the surgical procedure to be performed. The fluid of choice for Addisonian patients is 0.9% NaCl. During anesthesia it is very important to use an ECG to monitor for arrhythmias as well as a blood pressure monitor to watch for hypotension. Supplemental steroids should be given prior to induction of anesthesia and repeated every 2-4 hours perioperatively.

**Hyperthyroidism**

Hyperthyroidism occurs when there is continued excessive secretion of thyroid hormones by the thyroid gland. It is a common disease in older cats either male or female. 95% of the time hyperthyroidism occurs in cats older than 8 years of age. Most feline thyroid masses are benign with <2% as thyroid carcinomas. On the other hand, canine hyperthyroidism occurs most often with functional thyroid carcinoma. Either one gland or both glands may be affected. The cause of hyperthyroidism is unknown at this time. Symptoms can include weight loss despite an increased appetite, hyperactivity, polyurea, polydypsea, panting, vomiting, diarrhea, and lethargy. On physical exam may reveal the following; unkempt hair coat, poor body condition, palpable thyroid glands, tachycardia with a heart murmur called a “gallop rhythm” or arrhythmias. An ophthalmic exam may reveal retinal tears, retinal detachment or tortuous retinal blood vessels. Preoperative workup should include CBC, serum chemistries, urinalysis, T3 and T4 levels. Thyroid values are not always elevated and a mild elevation in liver and renal values is common. Thoracic radiographs should be taken prior to surgery in cats to screen for cardiomyopathy or pleural effusion. If cardiac signs are present a baseline preoperative ECG should be run. The most common arrhythmia is sinus tachycardia but ventricular arrhythmias and increased QRS voltage can also be seen. Hypertension is common for hyperthyroid patients so a baseline blood pressure reading prior to anesthesia is a good idea as well. Low stress is the key to handling hyperthyroid cats. They are in a hyperdynamic state and can often be fractious when handled. Restraint or other stressful situations can trigger a “thyroid storm” which is an intense release of thyroid hormone. The catecholamines released during stress are what predispose these patients to tachycardia, dysrhythmias, hypertension and hypoxemia due to increased oxygen demand. Respiratory distress, weakness, and cardiac arrest are possibilities. Atropine and glycopyrrolate should be avoided in the pre-anesthetic protocol. Low doses of acepromazaine are acceptable either with or without an opioid. The acepromazine will help with hypertension through vasodilation and provide sedation and possible antiarrhythmic effects. An opioid combined with the acepromazine will slow the heart rate and decrease myocardial oxygen consumption. Halothane gas should be avoided due to its tendency to increase cardiac arrhythmias. Isoflurane or Sevoflurane are preferred.
Perioperative intravenous fluid therapy is necessary to support blood pressure and renal function. In dogs, ECG readings are usually normal but cats should be closely monitored for arrhythmias and treated as necessary. Postoperative feline patients should be closely monitored for hypothermia. Most times these cats are geriatric and thin. If both thyroid glands are removed, serum calcium monitoring is essential. Signs of hypocalcemia can include facial twitching, ataxia, panting, restlessness, and seizures.

**Hypothyroidism**

Hypothyroidism is a syndrome that occurs as a result of decreased circulating serum thyroid hormone levels. It is a multisystemic disease in dogs that affects virtually all body systems resulting in a wide array of clinical signs. Hypothyroidism rarely occurs in cats. If possible the patient should be euthyroid or adequately treated for 1-2 weeks before being anesthetized. Complications can include decreased ventilation ability, bradycardia, hypotension, and hypothermia. Many of these patients are obese and therefore will not ventilate well on their own due to abdominal and intrathoracic fat. Ventilatory support such as mechanical ventilation or “bagging” the patient may be necessary. Hypothyroid patients may become bradycardic, therefore ECG monitoring is important to monitor heart rate and to watch for potential arrhythmias. Hypotension is another potential complication during anesthesia. Keep in mind that these patients can have a poor response to vasoconstrictors or positive inotropes. Temperature should be closely monitored to avoid hypothermia. Preventive steps can be taken by using a warm air blanket during and after surgery. Recovery time can be prolonged in hypothyroid patients and can be attributed to several factors. Obesity and the drugs lack of clearance from adipose tissue along with decreased metabolism can prolong the effects of anesthetic drugs. The choice of short acting drugs can be beneficial or consider reducing doses of longer acting drugs and tranquilizers.