**Breed Specific Anesthesia (focusing on brachycephalic and sighthound breeds)**

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Brachycephalic patient considerations:

In 2013 three of the top ten most popular breed of dog as determined by the AKC were breeds classified as brachycephalic.[i] So it only makes sense that as these breeds become more popular, you will be asked to anesthetize a brachycephalic patient. The brachycephalic breeds require special consideration when selecting anesthetic protocols as these breeds typically have anatomical abnormalities that cause some degree of upper airway obstruction. These abnormalities include: stenotic nares, an elongated soft palate, laryngeal collapse, hypoplastic trachea, and laryngeal saccule eversion. These abnormalities have been grouped together into what is known as *brachycephalic syndrome*.

Of the abnormalities listed above the most commonly seen with brachycephalic breeds are stenotic nares and an elongated soft palate. Stenotic nares is a condition in which the nostrils are malformed. Theses nostrils are narrow and sometimes collapse inward during inhalation making it difficult for the patient to breathe through its nose. An elongated soft palate is a condition where the soft palate is too long and the tip of it protrudes into the airway and interferes with inspiration of air into the lungs. Brachycephalic breeds tend to learn to compensate for these respiratory insufficiencies, but sedation and anesthesia removes these compensatory mechanisms. It them becomes the job of the anesthetist to monitor and protect the airway.

Often brachycephalic breeds present as excitable, nervous, skittish, or high strung. The tendency in those cases would be to use a higher dose of premedication which can have serious consequences in a brachycephalic patient. Deep sedation of these patients can be associated with excessive relaxation of upper airway muscles and worsened airway obstruction.[ii] Unless a patient is aggressive or dangerous to you, use lower doses of pre-medications. Also note that analgesic agents should always be used for surgical procedures. Opioids are the most frequently used pre-anesthetic analgesic agents. Opioids are not contraindicated simply because the patient is brachycephalic. Although it is thought that opioids cause respiratory depression, this is more of a dose dependent issue. Opioids commonly used for pre-medication include: morphine, hydromorphone, oxymorphone, fentanyl, buprenorphine, and butorphanol. The premedication also frequently involves a sedative component in the form

of an alpha-2 agonist such as dexmedetomidine, a tranquilizer such as acepromazine, or a benzodiazepine such as diazepam or midazolam. Unlike phenothiazines and benzodiazepines, Dexmedetomidine will also provide analgesia. When combined with other medications in the pre-medication, Dexmedetomidine may even provide sufficient analgesia and muscle relaxation for minor surgical procedures to be performed.[iii]

Brachycephalic breeds tend to have a higher vagal tone than other breeds. Impulses from the vagus nerve result in parasympathetic effects such as bradycardia, bronchoconstriction, and excessive saliva formation.[iv] Anticholinergics block muscarinic receptors, thus blocking the aforementioned parasympathetic effects. Anticholinergics (such as atropine and glycopyrrolate) can be beneficial if not contraindicated. Anticholinergics are given on a case-by-case basis and are not often included in the pre-medication unless deemed necessary. Cases where anticholinergics may not be warranted include patients that have cardiac disease in which you want to avoid tachycardia such as congestive heart failure.

After proper premedication has been administered it is recommended that brachycephalic patients be “pre-oxygenated” prior to the administration of induction drugs. Administration of 100% oxygen before induction of anesthesia prolongs the time to onset of arterial hypoxemia. This technique increases the body’s oxygen stores, primarily in the functional residual capacity (FRC) of the lungs.[v] Pre-oxygenation should only occur if it is not overly stressful to the patient. Induction should be rapid in order to gain control over the airway. When possible, use the following sequence of events: Pre-medicate/sedate, pre-oxygenate while placing IV catheter, Induction medication given IV, intubation when patient adequately anesthetized. Note that facemask inductions are not recommended for most brachycephalic patients as it is stressful and the edge of the facemask can damage the cornea of the patient. Induction agents that are rapidly metabolized are preferred in these patients.

When intubating a brachycephalic patient, expect to use a much smaller endotracheal tube. Carefully select a wide variety of sizes, but be ready with 2 tubes smaller than what you estimate to be the right size. A laryngoscope is a necessary tool for intubation, as the amount of redundant tissue in the pharynx may reduce the visibility of the laryngeal opening.

While under anesthesia patients can be maintained with inhaled anesthetic such as isoflurane or sevoflurane in 100% oxygen. Sevoflurane is metabolized faster than isoflurane allowing for a faster recovery.[vi] This may be an attractive choice when anesthetizing a brachycephalic patient. As with any other patient undergoing anesthesia monitoring during the

intra operative period is of utmost importance. It is ideal to use a multiparameter monitor that will give you information such as EKG tracings, %SPO2, capnography, temperature, and blood pressure. End tidal CO2 (ETCO2) readings are a valuable monitoring tool as it will tell you how well your patient is ventilating. ETCO2 is a non-invasive estimate of the patient's alveolar ventilation status by its close correlation with arterial carbon dioxide (PaCO2) under normal conditions. Normal canine and feline ETCO2 should be between 35-45mmHg.[vii]

The recovery period is an important time for the anesthetist to stay vigilant about patient monitoring. Appropriate post-operative medications should be administered, taking into account the level of pain anticipated from the surgery performed. Note that acepromazine has no analgesic properties and is not considered an adequate post-operative medication if a painful procedure has been performed. We want recovery to be smooth and stress free. Because brachycephalics can sometimes desaturate when in recovery, a portable pulse oximeter is a useful tool when in recovery. Brachycephalic patients should be recovered in sternal recumbency with their heard slightly elevated. Avoid overly aggressive initial stimulation, as this may trigger swallowing only to be followed by a relapse into unconsciousness when the stimulation is removed. It is important to have additional induction agent and additional endotracheal tubes ready in recovery in the event that airway obstruction and re-intubation is needed. Recovering these patients in an oxygen chamber is advisable; however a more effective tool is nasal oxygen during recovery. A nasopharyngeal tube can be placed and connected directly to an oxygen source to allow delivery of oxygen to the oral cavity during recovery.

In summary brachycephalic breeds have anatomical abnormalities that require the anesthetist to carefully monitor breathing and any airway disturbances. However, proper premedication, vigilant monitoring in the pre-operative to recovery stages, as well as a stress free induction and recovery, can make working with these patients less challenging and more rewarding.

Sighthounds:

The following is a brief summary of why sighthounds are "unique" when it comes to choosing a safe and effective anesthetic regimen. The keys to choosing anesthesia protocols are to understand the basics of anesthesia and that there is no "one right way" to do things. There are actually many anesthetics that are safe for sighthounds. The patients' medical history and your familiarity with the various anesthetics will determine which is the safest. Most

research has been done on Greyhounds, and the findings have been applied to other sighthounds

Sighthounds have unique physical characteristics that will influence anesthetic choices as well as monitoring needs. Sighthounds are commonly mistaken as being polycythemic, as they tend to have higher packed cell volumes 50-60%, where a normal canine is 35-55%.[viii] They also tend to have lower serum protein. The lower serum albumin concentrations can result in an increased effect of drugs that are highly protein bound (anesthetics). They are extremely deep chested and have greater lung capacity than other breeds of equivalent weight. Their body conformation and lack of body fat effects the redistribution of drugs.

Greyhounds are quite normally very quiet, cooperative, agreeable dogs that rarely need deep levels of sedation for restraint and control. Some Greyhounds that have recently come off a track environment will be nervous and more inclined to develop stress related clinical complications such as colitis, hypertension, and even hyperthermia.

In these cases appropriate levels of sedation as well as analgesia are important.

Sighthounds have a low body fat to muscle ratio. This makes them more susceptible to hypothermia when their own temperature regulatory mechanisms are impaired- such as under general anesthesia. Prevention of hypothermia is important as these breeds tend to cool down very rapidly. Once their temperature has dropped it can lead to significant problems such as bradycardia. Prevention of hypothermia can be achieved by using circulating warm water blankets, Hot Dog® warmers, Bair Huggers®, and warmed IV fluids during the procedure.

The liver metabolism of several drugs is different in sighthounds. There is a decrease in the activity of liver enzymes of the cytochrome P450 family. Cytochrome P450, are family of over 60 enzymes the body uses to break down toxins.[ix] This decrease in activity of liver enzymes can affect the metabolism of thiobarbituates, but evidence shows that other drugs such as methohexital and even propofol are cleared more slowly. Just as young, healthy animals are more able to exercise vigorously, they are more able to tolerate the depression in heart function caused by general anesthesia because they have such great cardiovascular reserve. Older or debilitated animals have less cardiovascular reserve and may have less tolerance for general anesthesia. Older or debilitated animals often recover from general anesthesia and surgery more slowly than a young patient, in part because of their decreased reserve. Before any anesthetics are administered it is important to obtain a baseline

temperature, heart rate and respiratory rate, as well as an ASA rating. On physical exam, Greyhounds can normally have a sinus arrhythmia (a condition where the heart rate increases with inspiration and decreases with expiration).

When selecting a pre-medication for a sighthound one should consider the ASA status of the patient as well as the anticipated level of pain associated with the procedure. Sighthounds usually do very well with a pre-medication classified as *Neuroleptal analgesia*- this is a technique of combing an opioid and sedative in the pre-medication. Analgesic agents should always be used for surgical procedures. Sometimes these breeds are very excitable, skittish, nervous, or "high strung". These patients are prone to tachycardia and hypertension in the clinical setting, also known as the "white coat effect". When confronted with sighthounds, the technician anesthetist should take this into consideration and make the pre-operative experience as calm as possible. This may include administering the pre-op sedative with the owner present or scheduling your sighthound patients to be done first in the order of the day. Your inclination may be to use higher does of pre-medication but this can be dangerous in a patient that is older, debilitated, or has reduced ability to clear anesthetic drugs. Unless the patient is a danger to you (it will bite, is known to be aggressive) use lower doses of pre-medications. You can always add more if needed.

Opioids are the most frequently used pre-anesthetic analgesic agents. Although it is thought that opioids cause respiratory depression this is more of a dose dependent issue. Examples of opioids for pre-medication: morphine, hydromorphone, oxymorphone, methadone, buprenorphine, nalbuphine and butorphanol. Morphine may be the most attractive opioid as it is the least protein bound opioid, which can be beneficial for sighthounds and their altered hepatic metabolism.[x]

The opioid can be combined with a benzodiazepine or tranquilizer such as acepromazine. These drugs have anti-anxiety and calming effects. Benzodiazepines have an advantage in that they are reversible (via flumazenil). While neither of these classes of drugs has analgesic effects by itself, they enhance the sedation and analgesia of other agents. Benzodiazepines do not commonly cause sedation in young healthy animals unless used in combination with other agents (opioids, ketamine, etc.). They may actually cause excitement, dysphoria, and ataxia in young healthy patients. Unlike phenothiazines and benzodiazepines, alpha 2 agonists like dexmedetomidine will also provide analgesia. When combined with other medications in the pre-medication, alpha 2 agonists may even provide sufficient analgesia and

muscle relaxation for minor surgical procedures to be preformed. Anticholinergics do not need to be part of the pre-surgical medication unless deemed necessary. (Example: in cases of pediatric patients who are dependent on heart rate for adequate cardiac output.)

Table of Sample anesthetic protocols used on sighthounds (ASA 1-2):

- Morphine (0.75mg/kg)+/- midazolam (0.20mg/kg)+/- “micro” dose of dexmedetomidine (0.005mg/kg) IM
- Morphine (0.75mg/kg)+ midazolam (0.20mg/kg)+ low dose acepromazine (0.02mg/kg) IM
- Can interchange morphine with other opioids such as oxymorphone, hydromorphone, fentanyl, etc.

Many induction agents can be safely used in sighthounds. Propofol can be used on patients in whom rapid recovery is desired such as brachycephalics, diabetics, older patients, and sighthounds. Propofol is capable of providing a smooth and rapid return to the patients’ pre-op state. Rapid administration of propofol can cause apnea, vasodilation, hypotension, and reduction in myocardial contractility. To avoid these unwanted side effects; plan on delivering the calculated dose over 90-120 seconds, stopping when the patient appears deep enough to intubate. It is best to always administer propofol near an oxygen supply and have intubation materials ready.

The neuro-steroid anesthetic alfaxalone is another induction choice with a short and rapid duration of action with minimal side-effects. In general its clinical use and properties can be compared to propofol. Unlike propofol, alfaxalone has little or no cardiovascular effects when given in the normal dosage.[xi] Similar to propofol, alfaxalone is an induction agent that, because of its short half-life in dogs and cats, is very suitable for repeated bolus injections or a continuous rate infusion (CRI). Another induction choice are the thiobarbiturates. There are several reasons why thiobarbituates are not ideal choices in the sighthound patient. They are extremely soluble in fat therefore they are absorbed almost immediately into fat after an injection into a vein. Secondly, they are then broken down by the liver and excreted in urine. Lastly, any remaining thiobarbiturate will redistribute to fatty tissues and the animal then recovers from anesthesia. Because sighthounds have little or no fat, thiobarbiturates remain in their bloodstream causing lengthy, prolonged recovery from anesthesia.

Isoflurane & sevoflurane are commonly used for maintenance of anesthesia. They are considered some of the safest common inhalant agents. With the exception of patients experiencing extreme respiratory compromise sevoflurane is rarely of any advantage over isoflurane.[xii]

During the anesthetic event, vigilant monitoring of the patient is necessary. It is best to use a multiparameter monitor that gives you information such as an electrocardiogram, pulse oximetry, temperature, capnography, and blood pressure. Sighthounds have a high surface to body ratio and therefore are more susceptible to hypothermia. The Hot Dog® patient warming system is an effective device for warming your patient during and after the anesthetic event. This warmer features flexible blankets made of electrically conductive fabric for even heat distribution. An advantage they possess over a Bair Hugger® is there is no blowing air on the surgical site, so it won't dry out EKG leads.

One very potentially life threatening condition called malignant hyperthermia (MH) can result in Greyhounds under anesthesia. This can be fatal and is associated with a rapid rise in body temperature that their body is unable to regulate. This rapid onset of changes in their metabolism as a result can lead to a shock like state. Malignant hyperthermia can be triggered from administration of anesthetic gas, stress from exercise, and trauma. During an episode of MH, the patient has an uncontrolled rise in myoplasmic calcium concentration, this leads to the increased oxygen consumption of skeletal muscle.[xiii] The patient will become hypoxic, begin to hyperventilate and the body temperature will increase rapidly. Anesthetic gas should be turned off and patient maintained on another anesthetic agent such as a continuous rate infusion of propofol. Treatment should include dantrolene, a muscle relaxant. This will lower the amount of calcium in the myoplasm.

Recovery of sighthounds often mimics the activity seen during pre-medication and induction. If the patient does not respond well to the drugs used in the premeds or has an extended "excitement phase" after initial induction, then they will most often have an eventful recovery. Excitement and pain in the post-operative period cause tremendous stress and serious side effects such as hypertension, tachycardia, and cardiac arrhythmias.[xiv] Sighthounds should always have analgesics administered if the surgical procedure was thought to be painful. Adding a sedative or tranquilizer to the analgesic will facilitate a smoother recovery. A small dose of the opioid used in the pre-medication combined with a low dose of acepromazine (0.01mg/kg) or dexmedetomidine is usually sufficient to facilitate a smoother recovery. For

cardiac healthy patients, a “mini” dose of dexmedetomidine within the range of 2-5 mcg/kg IV usually provides 30 minutes of sedation to move smoothly from anesthesia.

Sighthounds present unique challenges for the veterinary technician anesthetist. Because of their unique physiological characteristics anesthesia protocols should be tailored to reflect the ASA status of each patient as well as the anticipated pain level. With experience, sighthound anesthesia can move from scary to successful and rewarding.

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