HOW I DIAGNOSE & TREAT UPPER AIRWAY OBSTRUCTION

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DIAGNOSTIC EVALUATION

Oropharyngeal, nasopharyngeal, and laryngeal examination are critical parts of the evaluation of the patient with suspected upper airway obstruction. Knowledge of anatomy and understanding of appropriate sedation or anesthetic protocols are crucial for thorough assessment. The most common indications for upper airway evaluation in small animal veterinary medicine include cats with suspected nasopharyngeal polyps and dogs suspected to have brachycephalic airway syndrome or laryngeal paralysis. Often the upper airway is evaluated as an animal is being induced for general anesthesia. The nasopharynx and most of the laryngeal anatomy can be examined once an animal is intubated, however laryngeal function cannot be determined.

Intravenous thiopental administered to effect is believed to be the best anesthetic choice for assessment of laryngeal function. However, the recent lack of availability of thiopental leaves propofol as the most appropriate induction agent for laryngeal examination in dogs (Table 1). Doxapram HCl (1 mg/kg IV) has been advocated for routine use during laryngoscopy to increase respiratory rate and effort and improve intrinsic laryngeal motion, and it should be administered if the diagnosis is in doubt.

Laryngeal examination can be broken down into structural and functional parts. Structural examination is most often indicated in brachycephalic breeds to assess the length of the soft palate, presence of everted tonsils or everted laryngeal saccules, and degree of laryngeal collapse. A normal soft palate should just touch the tip of the epiglottis. To appropriately assess soft palate length, the tongue should be in a normal position. An elongated soft palate typically extends past the tip of the epiglottis by at least several millimeters. Everted laryngeal saccules are protrusions of the mucosa diverticula rostral to the vocal folds. The saccules obstruct the ventral aspect of the glottis and further inhibit airflow. It may be difficult for an inexperienced examiner to differentiate everted laryngeal saccules from the vocal folds because of the close proximity. However, in most studies regarding brachycephalic airway syndrome, everted laryngeal saccules are present in 50-60% of affected dogs. Laryngeal collapse is caused by loss of cartilage rigidity that allows medial deviation of the laryngeal cartilages. There are three stages of severity to laryngeal collapse. Stage 1 is the eversion of the laryngeal saccules into the glottis. During stage 2, the cuneiform processes of the arytenoid cartilages lose rigidity and collapse into the laryngeal lumen. In addition, the aryepiglottic folds collapse ventromedially. The most advanced phase of laryngeal collapse is stage 3 in which the corniculate process of each arytenoid cartilage fatigues and then collapses toward midline, resulting in complete laryngeal collapse.

Functional laryngeal examination is performed in animals suspected to have laryngeal paralysis. However, laryngoscopy is a poorly specific diagnostic test since false-positives are common because of the influence of anesthetic agents on laryngeal function. Echolaryngography, transnasal laryngoscopy, and CT avoid the need for heavy sedation and general anesthesia, however none of these methods have been shown to be superior to traditional oral laryngeal examination for definitive diagnosis.

Laryngeal paralysis is diagnosed based on the lack of arytenoid abduction during inspiration. Inflammation and swelling of the laryngeal cartilages can also be apparent. Diagnosis can be

confounded by the presence of paradoxical movement of the arytenoids, resulting in a false-negative result. In this situation, the arytenoid cartilages move inward during inspiration because of negative intraglottic pressure that is created by breathing against an obstruction. The cartilages then passively return to their original position during the expiratory phase, giving the impression of abduction. An assistant can state the stage of respiration during laryngoscopy to help distinguish normal from abnormal motion.

Pharyngeal examination under general anesthesia is required to evaluate an animal for nasopharyngeal masses. Nasopharyngeal polyps should be suspected in young to middle-aged cats who present with signs of upper airway obstruction, otitis media, and/or otitis externa. Care should be taken when anesthetizing cats with possible upper airway obstruction due to the potential for respiratory decompensation. The nasopharynx can be evaluated by a variety of methods:

1) Digital palpation of the soft palate
2) Soft palate retraction using a spay hook
3) Visual inspection of the dorsal nasopharynx using a dental mirror
4) Flexible fiberoptic endoscope that will retroflex over the soft palate

Polyps typically appear as smooth, shiny, pedunculated, and light pink in color. Differentials for nasopharyngeal polyps include neoplasia, foreign body, and granuloma.

Acute obstruction

Upper airway obstruction is a life-threatening condition that may require aggressive intervention. Dogs and cats with severe upper airway obstruction can present in respiratory distress with marked inspiratory and likely expiratory stridor. Animals can be cyanotic and hyperthermic. The signalment of the animal can be very helpful in determining the potential underlying cause. Older large-breed dogs, particularly Labrador retrievers, can have acute exacerbation of laryngeal paralysis, while middle-aged toy or small breed dogs can be suffering from tracheal collapse. Brachycephalic breeds presenting in respiratory distress have Brachycephalic Airway Obstructive Syndrome (BAOS) until proven otherwise. Young cats can have nasopharyngeal polyps, while laryngeal paralysis or masses can occur in middle-aged to older cats.

Initial treatment is directed at improving ventilation, reducing laryngeal edema, and minimizing the animal's stress. A typical treatment regimen in dogs involves oxygen supplementation and administration of short-acting steroids and sedatives (Table 2). Administration of acepromazine, buprenorphine, butorphanol, or midazolam can be considered in both dogs and cats that are in distress. Supplemental oxygen is administered by nasal insufflation, flow-by, face mask, oxygen cage, or endotracheal intubation. These animals are often also hyperthermic and appropriate cooling procedures should also be instituted.

If respiratory distress cannot be abated, intubation or a temporary tracheostomy should be considered. However, temporary tracheostomies are associated with significant complications, particularly obstruction from blood clots or mucus. In a recent study, complications (clinical and incidental) were documented in 86% of cases receiving a temporary tracheostomy. Sixteen types of complications were noted, but the most significant and frequent complications occurred in ~25% of dogs and were airway obstruction, tube dislodgement, aspiration pneumonia, and stoma swelling. Therefore, intensive monitoring of a patient with a temporary tracheostomy tube is required to avoid life-threatening complications. This procedure has also been shown to make dogs with laryngeal paralysis more at risk for aspiration pneumonia postoperatively.

To perform a temporary tracheostomy, a small midline incision is made through skin and subcutaneous tissue along the ventral neck. The sternohyoideus muscles lie directly over the ventral aspect of the trachea. A midline separation between the two muscles is usually apparent and the muscles are divided using blunt dissection. A small self-retaining retractor is used to retract the soft tissues away from the trachea. Care is taken to avoid any dissection or manipulation lateral and dorsal to the trachea. In most animals, a transverse (horizontal) incision is made between the third and fourth or fourth and fifth rings. For animals less than 5 kg, such as kittens, puppies, and small mammals, a longitudinal (vertical) incision is made on midline across two to three rings. Regardless, positioning is critical for the procedure as the surgeon needs to be directly on midline in order to avoid damage to other anatomical structures in the area. Padding may be placed under the neck to bring the trachea closer to the skin surface and make the procedure slightly easier.

Prior to incision in the trachea, stay sutures (2-0 to 3-0 nonabsorbable monofilament) are placed in the ring above and below where the transverse tracheotomy incision is to be made. The stay sutures should be knotted into a loop around each tracheal ring with the free ends left long. Avoid cinching the suture directly down onto the tracheal ring. A #11 or #15 blade is used to make a horizontal or transverse incision between the two tracheal rings. No more than one-half of the circumference of the trachea should be incised. The size of tracheostomy tube placed into the tracheal incision is based on the luminal diameter of the trachea at that level. If necessary, subcutaneous tissue and skin may be sutured around the tracheostomy site, but small incisions are usually left alone. The tube is secured to the patient by tying umbilical tape or rolled gauze to the tube and around the animal's neck. Once a tracheostomy tube is no longer necessary, the safety sutures around the rings are removed and the surgical site is left to heal by second intention.

On an emergency basis, standard endotracheal tubes can be used as temporary tracheostomy tubes. Actual tracheostomy tubes come with either a single or double-lumen and are either cuffed or non-cuffed. Double-lumen tubes are ideal as the inner cannula can be removed and cleaned with the outer cannula still in place. Unfortunately, even the smallest double-lumen tube may be too large for small dogs or cats. Single-lumen tubes must be removed completely in order to be cleaned which may cause some distress to the animal. Cuffed tubes are used in patients undergoing general anesthesia or requiring mechanical ventilation. The tubes must be used with extreme care as overinflation or prolonged inflation of the cuff can result in focal tracheal necrosis.

SURGICAL TREATMENT OF BRACHYCEPHALIC SYNDROME

Stenotic nares

Brachycephalic breeds may have a congenital malformation of the nasal cartilages resulting in medial collapse and restriction of airflow into the nasal cavity. Stenotic nares are easily correctable. Various surgical techniques are used and all have the same end result: permanent enlargement of the external nares. Techniques include wedge resection, nares amputation (Trader's technique), and alapexy. For wedge resection, a #11 scalpel blade, Baker's biopsy punch or laser can be used to make deep and even cuts in the wing of the nostril. There is no difference in outcome between a horizontal or vertical wedge resection. Hemorrhage is expected, but bleeding is managed by digital pressure and then controlled once sutures are in place. Absorbable 4-0 (1.5 metric) multifilament or monofilament suture in a simple interrupted pattern is used to appose cut surfaces.

Elongated Soft Palate

Heavy sedation or a light plane of general anesthesia is required to adequately assess the palate and larynx. A normal soft palate should just touch the tip of the epiglottis. To appropriately assess soft

palate length, the tongue should be in a normal position. An elongated soft palate typically extends past the tip of the epiglottis by at least several millimeters.
Soft palate resection is a relatively simple procedure. The most important aspect of the surgery is to make sure that the palate is not made too short. The consequences of a short soft palate are nasal regurgitation and rhinitis. The procedure is typically performed by placing stay sutures on either side of the palate at the level of planned resection. Recent technique descriptions describe resecting the soft palate at the level of the cranial commissure of the tonsilar crypt, although most surgeons use the mid to caudal body of the tonsil as a landmark. Metzenbaum scissors are used to transect approximately one-third to one-half the width of the palate. A simple continuous pattern with 4-0 (1.5 metric) monofilament or multifilament absorbable suture is used to oppose the nasal and oral mucosa over the exposed palatine muscle. Removal of the rest of the palate is performed and the suture line is continued to the opposite side. Hemorrhage and swelling are usually minimal, but premedication with dexamethasone (0.5mg/kg, IV) is often routine.
Soft palate resection may also be performed using surgical laser or Ligasure®. In a prospective study of 20 brachycephalic dogs undergoing soft palate resection, surgical time for laser resection was significantly shorter than traditional resection. However, clinical outcomes were similar between the two groups.

Everted Laryngeal Saccules and Laryngeal Collapse
Chronic upper airway obstruction from elongated soft palate and stenotic nares causes increased airway resistance and increased negative intraglottic luminal pressure. Over time, this results in laryngeal collapse due to cartilage fatigue and degeneration. There are three stages of laryngeal collapse:

Stage 1 – everted laryngeal saccules
Stage 2 – aryepiglottic collapse
Stage 3 – corniculate collapse

In a retrospective study of dogs with brachycephalic airway syndrome, everted laryngeal saccules were present in almost 50% of dogs. The saccules are pulled from their crypts due to the high negative pressure within the glottis. Once the saccules are everted, the tissue is exposed to highly turbulent airflow resulting in swelling which further obstructs the airway.
Resection of the everted laryngeal saccules is relatively simple. Each saccule is grasped with Allis tissue forceps and then sharply transected with Metzenbaum scissors. Suturing is not necessary. The difficulty of this technique lies is getting good visualization of the larynx and glottis. Often these dogs have redundant pharyngeal tissue that swells rapidly with minimal handling. The presence of an endotracheal tube can also make visualization difficult.
Laryngeal collapse is the end-stage component of brachycephalic airway syndrome. Weakened laryngeal cartilages become displaced medially, severely obstructing the airway. Options for treatment at this stage are limited. First, all other underlying conditions (stenotic nares, elongated soft palate, everted laryngeal saccules) are addressed. Unilateral arytenoid lateralization techniques are rarely successful, as the opposite cartilage will continue to collapse medially. Bilateral arytenoid lateralization techniques are considered unacceptable due to the high risk for aspiration pneumonia. Partial arytenoidectomy procedures have also been associated with a high rate of complications and perioperative mortality. Permanent tracheostomy is the recommended treatment for stage 3 laryngeal collapse, although many owners consider this an unacceptable option.

Prognosis
Surgical correction of brachycephalic airway syndrome will alleviate signs of respiratory distress and improve quality of life in most dogs. The degree of improvement is usually dependent on how severely the dog is affected preoperatively. Dogs corrected for stenotic nares and elongated soft palate had a

better postoperative response than dogs with elongated soft palate alone. A recent study describes a good to excellent long-term outcome in 94%. English bulldogs have been found to have a worse response to surgery when compared to all other breed combined and are far more likely to develop aspiration pneumonia postoperatively. An association with gastrointestinal disease has been investigated in Europe. It is believed that brachycephalic dogs surgically treated for upper airway disease and concurrently medically managed for gastrointestinal disease have an overall better outcome. Without surgery, prognosis for dogs with elongated soft palate and everted laryngeal saccules is guarded, as respiratory signs and laryngeal collapse will progress over time.

SURGICAL TREATMENT OF LARYNGEAL PARALYSIS

Laryngeal paralysis is a surgical condition. Numerous surgical techniques are available to treat laryngeal paralysis. Unilateral arytenoid lateralization is the current technique of choice for most surgeons, but various methods of partial laryngectomy (bilateral ventriculocordectomy, partial arytenoidectomy) are also performed. Bilateral arytenoid lateralization is not recommended as it has been shown to result in unacceptable morbidity. Other techniques include castellated laryngofissure, reinnervation of the laryngeal musculature, and permanent tracheostomy. Permanent tracheostomy is considered a salvage procedure for dogs most at risk for aspiration pneumonia, but it is associated with a high rate of major and minor complications and requires diligent postoperative and long-term care.

Several variations of unilateral arytenoid lateralization have been described. The most common technique involves suturing the cricoid cartilage to the muscular process of the arytenoid cartilage. This mimics the directional pull of the cricoarytenoid dorsalis muscle and rotates the arytenoid cartilage laterally. Increasing the surface area of the rima glottis beyond the edges of the epiglottis may put the animal more at risk for aspiration. Limited lateral displacement of the arytenoid cartilage will significantly reduce airway resistance within the larynx and may decrease the risk for postoperative aspiration pneumonia. This is accomplished by minimizing the degree of dissection: separation of the cricothyroid articulation, transection of the sesamoid band connecting the paired arytenoid, and complete disarticulation of the cricoarytenoid joint are not necessary. A partial opening of the cricoarytenoid articulation allows accurate visualization of needle placement through the muscular process of the arytenoid, but limits the degree of arytenoid cartilage abduction.

Prognosis

Aspiration pneumonia is the most common complication in dogs surgically treated for laryngeal paralysis. Although aspiration pneumonia occurs most likely in the first few weeks following surgery, it has been recognized that these dogs are at risk for aspiration pneumonia for the rest of their lives. Factors that have been significantly associated with a higher risk of developing complications and influencing long-term outcome include preoperative aspiration pneumonia, development of esophageal dysfunction, progression of generalized neurologic signs, temporary tracheostomy placement, and concurrent neoplastic disease. Without surgical complications, unilateral arytenoid lateralization results in less respiratory distress and stridor and improved exercise tolerance. Owner satisfaction with this procedure has been reported as excellent, with the majority of owners believing that the quality of their dog's life was dramatically improved.

SUGGESTED READING:

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Table 1. Drugs Used During Functional Laryngeal Examination

Premedications:

Glycopyrrolate: 0.005-0.01 mg/kg IV, IM, SC *and*
Butorphanol: 0.2-0.4 mg/kg IV, IM, SQ *or*
Buprenorphine: 0.005-0.02 mg/kg IV, IM, SC *or*
Hydromorphone: 0.1-0.2 mg/kg IV, IM, SC

Induction:

Propofol: 4-8 mg/kg IV, administered slowly

To stimulate respiration:

Doxapram HCl: 1-2 mg/kg IV

To decrease laryngeal swelling:

Dexamethasone: 0.1-1 mg/kg IV

Table 2. Drugs Used for Acute Respiratory Distress

To decrease laryngeal swelling:

Dexamethasone: 0.1-1.0 mg/kg IV

To abate anxiety:

Acepromazine 0.01-0.02 mg/kg IV

Buprenorphone 0.0005-0.001 mg/kg IV

Butorphanol 0.1-0.25 mg/kg IV