BRACHYCEPHALIC AIRWAY SYNDROME

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Brachycephalic breeds (Shih Tzu, boxer English and French Bulldog, Pekingese, pug and Boston terrier) have a shortened skull compared to the other breeds. Compression of the nasal passage and distortion of the pharyngeal tissue result in an increase in airway resistance. Brachycephalic airway syndrome includes stenotic nares, elongated soft palate, everted laryngeal saccules and laryngeal collapse. There is a high incidence of hypoplastic trachea found in brachycephalic dogs that contributes to airway distress.

Stenotic nares and elongated soft palate are the primary anatomic components of the syndrome while everted laryngeal saccules with laryngeal collapse are thought to be secondary. Excessive negative pressure generated at inspiration because of stenotic nares creates inflammation and stretching of soft tissue and eventually eversion of the laryngeal saccules and laryngeal collapse. Stenotic or obstructed nares affect the mechanics of the lungs and provoke degenerative changes of the nasal mucous membrane. Severe upper airway obstruction can result in pulmonary edema because of a reduction of intrathoracic pressure. The greatest changes are observed in dogs with partial bilateral nasal obstruction and high nasal resistance. Inadequate pulmonary ventilation due to upper airway obstruction can lead to a reduction of arterial oxygen content. The hypoxia is a potent pulmonary vasoconstrictor to divert away blood from poorly ventilated alveoli. Pulmonary vasoconstriction and pulmonary hypertension result in cor pulmonale and right sided heart failure.

CLINICAL FINDINGS AND DIAGNOSIS

Brachycephalic breeds are presented for excessive noisy breathing and inspiratory dyspnea. Inspiratory dyspnea is exacerbated by exercise and augmentation of the ambient temperature. Some English Bulldogs have been presented for vomiting not associated with meals. An increased frequency of hiatal hernia seems to be present in English Bulldogs with brachycephalic airway syndrome. The mean age for dogs presented is 3 to 4 years old. Many of these animals have a high potential to decompensate and develop acute respiratory distress. Therefore, they must be handled carefully to prevent stress and acute decompensation. It is important to keep the animal calm and in a cool environment. Supplemental oxygen might be required.

Physical examination of the nares for stenosis should be performed. Breathing pattern should be observed. Brachycephalic dogs are presented with an inspiratory dyspnea that is corrected by open mouth breathing if only the nares are involved in the syndrome. If the soft palate is elongated, the laryngeal saccules and/or the larynx collapsed the dyspnea is inspiratory and expiratory. The severity of inspiratory dyspnea depends on the length and congestion of the soft palate and other restrictive or obstructive conditions present. An obstructive breathing pattern, characterized by a slow inspiratory phase followed by a rapid expiratory phase is seen frequently in brachycephalic breeds, even if the airway diameter is not compromised more than 50%. In nonbrachycephalic breed, a reduction of more than 50% of the airway diameter is required to modify the breathing pattern. The greatest airway noise is usually noticed in the larynx. Auscultation of the lung field is difficult because of enhanced upper airway sounds.

A radiological examination of the larynx shows an elongated soft palate protruding in the rima glottidis. It is also important to evaluate the diameter of the trachea in dogs with brachycephalic syndrome. It is very common to diagnose an hypoplastic trachea, which worsens the prognosis. Comparison of the diameters of the thoracic inlet (TI) and the tracheal lumen (TD) makes the diagnosis of tracheal hypoplasia. In normal Bulldogs, the ratio TD/TI is 0.106, English Bulldogs have the highest incidence of hypoplastic trachea within brachycephalic breeds (55%). Thoracic radiographs allow evaluation of lung fields for signs of pulmonary edema, pneumonia and the heart for signs of right-sided dilation. If there is cardiac enlargement, an echocardiography and an electrocardiogram are required to evaluate myocardial function and arrhythmias. Diagnosis of hiatal hernia can also be done with radiographs.

Blood work is usually within normal limits since the animals are young at the time of diagnosis. An augmentation of the packed cell volume might be indicative of a mild to moderate hypoxia.

A laryngeal examination is required under light general anesthesia to visualize the soft palate, the laryngeal saccules and the function of the larynx. The soft palate should not extend past the tip of the epiglottis. Position of the soft palate is influenced by the position of the head, traction on the tongue and presence of an endotracheal tube. Evaluation of the soft palate should be performed without an endotracheal tube in place and with the tongue in a normal position. Everted laryngeal saccules are white shiny dome-shaped structures located cranial to the vocal cords. Tonsils should also be evaluated as well as the presence of redundant mucosal folds in the pharynx/larynx. A medial tipping of both corniculate processes and medial flattening of the cuneiform processes of the arytenoid cartilage characterize a laryngeal collapse. The vocal cords are usually not visualized if the larynx is collapsed. Usually the corrective surgery is performed during the same anesthesia because recovery from anesthesia with compromised airways could be life threatening.

Stenotic nares are frequently diagnosed in younger, brachycephalic dogs (less than 2 years) with an overlong soft palate and have a favorable prognosis after surgical treatment. In brachycephalic dogs older than 2 years, stenotic nares are associated with additional airway obstruction, and these patients have a guarded prognosis even with treatment. Surgical treatment is
therefore recommended as soon as possible to prevent further deterioration of the animal’s condition and prognosis. English Bulldogs are not responding as well as the other breeds to surgery, probably because of the higher incidence of hypoplastic trachea in this breed.

SURGICAL TREATMENTS - STENOTIC NARES
In brachycephalic breed the cartilage plates are short, thick and displaced medially. Stenotic nares are present in 48% of dogs presented for brachycephalic airway syndrome. Stenotic nares are frequently found in brachycephalic dogs, and interference with inspiration by the obstructed nares leads to secondary airway changes (i.e., everted saccules, laryngeal collapse, tracheal collapse). Stenotic nares have also been reported in cats.

The wing of the nostril is examined to determine the amount of tissue to be removed for optimal airflow. The technique of removing a vertical wedge from the wing of a nostril and extending the incision caudally to include part of the alar cartilage has been useful in eliminating stenosis. The incision is made with a # 11 Bard-Parker blade. The tip of the blade is introduced at the apex of the wedge and directed caudally, with the cutting edge directed medially to the free edge of the wing of the nostril. The apex of the wedge is the pivot point of the flap created to allow the edges of the incision to come together evenly and without tension. The blade is again introduced at the apex of the wedge, and the cutting edge directed ventrolaterally as the tip is pushed in caudally to end at the same point as the first incision. The width of the base of the wedge (free edge) determines the opening of the nostril. The wedge is removed, and the edges are sutured with two or three interrupted sutures performed with 3-0 or 4-0 absorbable material using a small half-circle cutting needle.

The surgical site is kept clean and protected from rubbing (self-mutilation) with an Elizabethan collar. Additional medical care is usually not needed.

ELONGATED SOFT PALATE
In brachycephalic breed the soft palate extends beyond the epiglottis obstructing the airway passage. Vibration of the soft palate in the pharynx induces inflammation and swelling that will obstruct even more of the airway. Approximately 80 per cent of cases of overlong soft palate are found in brachycephalic dogs, English and French bulldogs being the most frequently afflicted. Edematous pharyngeal mucosa and enlarged, protruding tonsils are common. The intention of palate resection is to shorten the soft palate so that its free border lies at the tip of the epiglottis or just covers it with the tongue in a normal position.

The mouth is held open with a mouth gag, and the tongue is extended to provide adequate exposure of the oral pharynx. A pair of malleable ribbon retractors is helpful in moving soft tissues while the resection level is being determined. The free border of the palate is grasped with forceps, and both sides of the palate as well as the oral cavity are swabbed with antiseptic. The tongue is relaxed, and the point at which the tip of the epiglottis touches the soft palate is noted and marked with a scalpel cut or a sterile felt-tipped marking pen. The caudo-dorsal part of tonsils can also be used as a cranial landmark for the soft palate. A pair of Allis forceps or a traction suture is placed in the free edge of the palate and retracted rostrally. An absorbable suture (4-0 to 5-0) is placed in the mucosa at the lateral edge of the free soft palate. The visualization is not always good in the mouth of brachycephalic dogs. It will open the surgical field and improve the visualization if the procedure is performed with long and curved instruments. The palate is incised from the lateral traction suture to the reference mark at its midline with a scalpel or scissors while low tension is applied on the forceps and lateral traction suture. The soft palate is completely excised. The incised edge is sutured with a simple continuous pattern, with sutures placed through both the nasal and oral mucosa, 1 mm from the cut edge and 2 mm apart. The layer of muscle is avoided so that the mucosa is pulled over the exposed muscle when the sutures are tightened. The closely placed sutures provide a smooth hemostatic closure and do not shorten the width of the soft palate. Postoperative hemorrhage or edema is minimal.

EVERTED LARYNGEAL SACCULES
Everted laryngeal saccules are most frequently encountered in brachycephalic breeds, with a prolonged history of upper airway obstruction. Everted laryngeal saccules have been present in 48% of the brachycephalic dogs in a study. The mucosa of the laryngeal saccules everts in the larynx because of the high negative pressure during inspiration. The prolapsed mucosa is edematous and creates a mass in the larynx that contributes to the obstruction of the ventral rima glottidis. Resection of everted saccules is not performed routinely. Correction of other components of the syndrome might result in the reduction of the everted saccules.

A temporary tracheostomy is necessary to ensure an adequate airway during surgery and during postoperative recovery. Temporary tracheostomy allows removal of the endotracheal tube from the surgical site and helps manage the airway after the surgery.

A patient is placed in sternal recumbency with the mouth held open as described for partial laryngectomy. The saccule is grasped with long hemostats or Allis forceps, and rostral traction applied. The saccule is amputated at its base with scissors or a long-handled scalpel. Hemorrhage is minor and controlled by pressure. Avoiding the electroscapecal reduces inflammation.

Resection of everted saccules is associated with edema and swelling of the larynx. Dexamethasone intravenously (1 mg/kg) is used to reduce the amount of edema after surgery. The temporary tracheostomy is maintained for 24 hours after surgery. The patient is challenged before removal of the temporary tracheostomy tube.
LARYNGEAL COLLAPSE

Laryngeal collapse occurs as a result of a loss of the supporting function of the cartilages. It represents a very advanced form of the brachycephalic airway syndrome. The cuneiform and corniculate cartilages are drawn medially by the excessive inspiratory negative pressure. Laryngeal collapse is a progressive disease in which the prognosis worsens with time. Collectively, stenotic nares, elongated soft palate and everted laryngeal saccules predispose dogs to abnormal stresses within the larynx that lead to progressive distortion and ultimate collapse of the arytenoid cartilages.

Three stages of laryngeal collapse have been described (stages 1 to 3), stage 3 being the most advanced. The first stage in the pathogenesis of laryngeal collapse involves eversion of the laryngeal saccules into the cavity of the glottis. This is caused by an abnormal negative pressure created at the glottis during inspiration. The vacuum that develops in the glottis results from the increased inspiratory effort necessary to ventilate through the stenotic nares or elongated soft palate. Inflammation and edema of the mucosa usually accompany saccule eversion and contribute to the dyspnea. During stage 2, the cuneiform process of each arytenoid cartilage, which normally extends to the caudolateral region of the pharynx during inspiration, loses its rigidity and gradually collapses into the laryngeal lumen. In stage 3, the corniculate process of each arytenoid cartilage, which normally maintains the dorsal arch of the glottis, collapses toward the midline, resulting in complete collapse of the larynx. Loss of laryngeal cartilage rigidity is speculated to contribute to the collapse of the cuneiform and corniculate process. Dogs with stenotic nares, an elongated soft palate, or everted laryngeal saccules are treated for these conditions first. A dog is allowed to recover, and the clinical response suggests whether further resection is necessary.

Dogs with persistent stage 2 disease, even after resection of the soft palate and nares, may require partial arytenochordectomy to enlarge the laryngeal opening. Dogs with stage 3 laryngeal collapse may not show significant improvement when treated with partial laryngectomy. An alternative treatment for dogs with severe laryngeal collapse that does not improve after resection of the elongated soft palate, stenotic nares, or laryngeal saccules is a permanent tracheostomy.