

## **Brachycephalic Airway Syndrome (BAS)**

Brachycephalic breeds have become increasingly popular, which translates into an increased number of brachycephalic patients, many of which are clinically affected by airway disease. Brachycephalic airway syndrome (BAS), brachycephalic syndrome (BS), and brachycephalic airway obstructive syndrome (BAOS) are synonymous terms used to describe the cluster of anatomic abnormalities seen in brachycephalic breeds that contribute to dysfunction of the upper airway. The primary anatomic components of BAS include stenotic nares and elongated soft palate, though other commonly recognized components include tracheal hypoplasia and nasopharyngeal turbinates. Secondary complications from chronic increased resistance to airflow include everted laryngeal sacculles, tonsillar eversion, laryngeal collapse, tracheal collapse, and syncope. In addition to the recognized clinical signs of upper airway obstruction, affected animals may suffer from various gastrointestinal conditions, sleep apnea, and cardiovascular disease, which can contribute to the treatment and management challenges of these patients.

The average age of presentation for brachycephalic syndrome is 4 years, though English bulldogs are often presented earlier in life. Clinical signs typically include stertor, exercise intolerance, heat intolerance, and dyspnea. In more severe cases owners may report cyanosis and collapsing episodes. Patients may experience regurgitation of foam or saliva during episodes of distress. In addition to respiratory signs, many dogs with brachycephalic airway disease experience concurrent gastrointestinal signs including regurgitation, gastroesophageal reflux, and vomiting. These issues are of a particular concern due to the increased risk of aspiration pneumonia in animals clinically affected by their brachycephalic anatomy.

Ancillary diagnostics for each patient should be tailored to the severity of the disease and clinical presentation. Routine biochemical tests (CBC, Serum Chemistry, urinalysis) will be warranted in most patients as are thoracic radiographs which may reveal evidence of tracheal disease, pulmonary parenchymal changes, esophageal changes, hiatal hernia, as well as cardiovascular disease. Caution must be exercised when diagnosing tracheal hypoplasia when bronchopneumonia is present, as inflammation and edema of the trachea during an active airway infection may worsen the appearance of hypoplasia. Additional diagnostics to consider include abdominal radiographs, abdominal ultrasound, fluoroscopy, upper GI endoscopy, tracheoscopy and bronchoscopy, and head and neck CT.

Pharyngeal and laryngeal exam performed under a light plane of anesthesia are required to make a definitive diagnosis of brachycephalic syndrome. During the exam the entire pharynx and larynx should be evaluated for both anatomical and functional changes. Oral examination should include assessment of the length of the soft palate, size and shape of the rima glottis, laryngeal sacculles for eversion, and for laryngeal collapse. Retroflexed endoscopy of the nasopharynx may show nasopharyngeal inflammation, collapse, or the presence of nasal turbinates protruding in the

nasopharynx, which has been documented in approximately 20% of dogs symptomatic for BAS. Bronchoscopic evaluation of dogs with BAS presenting for surgery showed that 87% of dogs had some degree of bronchoscopically detectable collapse or stenosis, and that worsened degree of bronchial collapse was associated with laryngeal collapse. Upper gastrointestinal flexible endoscopy is helpful to evaluate for esophagitis, gastritis, reflux, hiatal hernia, and pyloric stenosis, which have been found in up to 80% of BAS patients, with worsened gastrointestinal signs correlated with worsened respiratory clinical signs.

Medical and surgical treatments are typically indicated for brachycephalic airway disease patients. There are no set guidelines that dictate the optimal time for surgical intervention, however any patient diagnosed with any of the primary components of brachycephalic airway disease or any animal presenting with clinical manifestations the disease should be considered a surgical candidate, regardless of age. First line medical management of BAS includes weight loss, control of excitement and activity triggers, medical treatment for gastrointestinal signs, and treatment of underlying pulmonary parenchymal disease. Treatment with H<sub>2</sub> blockers, proton pump inhibitors, and promotility agents (cisapride, metoclopramide) have all been described in brachycephalic patients with varied success.

Surgical treatments are aimed at relieving the upper airway obstruction through widening of the stenotic nares, shortening of the soft palate, and removal of everted laryngeal sacculae. There are numerous techniques described for both widening the nares and treating the elongated palate. In most cases the techniques utilized are based on surgeon's preference and experience. Since the nasal passage creates the most resistance to airflow, widening the nares is argued by some to be the most important aspect of surgery for BAS, especially since many of the other airway changes are considered to be secondary to stenotic nares. Therefore, widening of the nares at a young age is proposed, and has been shown to provide significant improvement in respiratory signs regardless of the surgical technique utilized. Correction of other components of BAS, including soft palate resection, and resection of everted laryngeal sacculae, may also be needed, and can be helpful even in advanced BAS cases with laryngeal collapse. Tracheal hypoplasia and bronchial collapse has not been associated with outcome in dogs undergoing surgical intervention for BAS.

The greatest challenge with BAS cases lies in the immediate pre- and post-operative management. Pre-oxygenation for a period of 5 minutes prior to induction has been shown to help prevent rapid drops in SpO<sub>2</sub> during induction and just prior to intubation. Consideration should be given to the administration of anti-emetics and gastroprotectants as part of the pre-medication in hopes of decreasing the likelihood of regurgitation and vomiting. Major complications associated with surgery include airway obstruction secondary to soft tissue inflammation, aspiration pneumonia, and respiratory arrest. All patients require intensive monitoring during anesthetic recovery and the subsequent 12-24 hours to ensure that any signs of respiratory distress are quickly recognized and treated appropriately, including performing a temporary tracheostomy if needed.

Veterinary literature reports an overall peri-operative mortality rate of 4% with most of these deaths occurring secondary to aspiration pneumonia. Minor complications can include bleeding, dehiscence of the alarplasty incision, recurrent stenosis, nasopharyngeal reflux, and chronic rhinitis.

While many patients have improvement of clinical signs following surgery, almost all animals will continue to exhibit some degree of upper airway obstructive signs. There has been conflicting evidence in the literature regarding determinants of long term prognosis with more recent studies showing that no single component confers a worse prognosis, including the presence of hypoplastic trachea. The presence of severe laryngeal collapse is thought to carry a worse long term prognosis, however even patients with stage 3 laryngeal collapse showed significant improvement of clinical signs following treatment of stenotic nares, elongated soft palate, and everted laryngeal saccules. Unfortunately, there is a population of dogs that may not benefit from surgery or may have progression of secondary changes that necessitates salvage surgery such as a permanent tracheostomy.