

# Brachycephalic Airway Syndrome: Tips for Successful Diagnosis and Surgery

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Brachycephalic syndrome refers to a combination of abnormalities in the nose, mouth and trachea of certain breeds of dogs that can cause significant respiratory abnormalities. Most commonly, patients present with stenotic nares, an elongated soft palate, and everted laryngeal sacculles. Several components of brachycephalic syndrome can be surgically corrected and dogs can have a good prognosis if the disease is not too advanced.

## **Etiology and pathophysiology**

Brachycephalic dogs and cats have early ankylosis in the cartilages at the base of their skull, leading to a shortened longitudinal skull axis. The most common breeds affected by brachycephalic syndrome include English bulldogs, French bulldogs, Pugs, and Boston terriers. Cavalier King Charles spaniels, Shih-Tzus, and Pekinese are also over-represented. Less commonly, Yorkshire terriers, Boxers, Chihuahuas, Maltese and miniature pinschers may also be affected.

The pathophysiology of brachycephalic syndrome is complex. Animals affected with this condition have primary abnormalities that obstruct airflow and cause increased airway resistance. Increased airway resistance causes negative pressure within the pharynx and larynx that exceeds the resistance of surrounding tissues and leads to collapse of secondary structures (such as the larynx). At the same time, increased airway resistance also causes soft tissues to be drawn into the airway lumen causing these tissues to become hyperplastic. The hyperplastic tissues and collapse of secondary structures leads to even increased airway resistance causing more hyperplasia and further collapse.

The primary components of brachycephalic syndrome are congenital and include stenotic nares, elongated soft palate, tracheal hypoplasia, as well as alternate turbinate anatomy, macroglossia and redundant pharyngeal mucosa. Secondary components include everted laryngeal sacculles, laryngeal collapse, everted tonsils and mucosal hyperplasia. A recent study by Fasanella et. al determined component prevalence in brachycephalic dogs. Most dogs had an elongated soft palate, while up to 53% had evidence of laryngeal collapse on presentation.

Many brachycephalic dogs will have a history of gastrointestinal signs such as ptyalism, regurgitation and vomiting. Recent studies have shown that upper GI endoscopy with biopsies revealed frequent gastritis and duodenitis in these patients, and that many dogs will have significant improvement of GI signs following airway surgery.

## **Clinical diagnostics**

Physical examination, thoracic radiographs and an oral exam under sedation or general anesthesia are used to make the clinical diagnosis of brachycephalic syndrome.

Clinical signs of brachycephalic syndrome include snoring, stertor, exercise intolerance, increased respiratory effort, cyanosis, hyperthermia and collapse. Median age at presentation is approximately 3 years of age, although patients may be much younger or older at presentation.

Stenotic nares are nares that have an opening that is smaller than normal. This is a subjective assessment made by examining the patient's face and visualizing the nose opening.

The nares can account for up to 80% of airway resistance and treatment of stenotic nares should always be performed in dogs. Often stenotic nares are the only treatable component in cats with brachycephalic syndrome.

An elongated soft palate refers to a palate that is excessively long when compared to anatomic landmarks within the pharynx. Landmarks that are used to evaluate the length of the palate are the tip of the epiglottis and the caudal tonsillar crypt. The palate should not extend past either of these structures. It is vital that the tongue is kept in a normal anatomic position during the oral exam as pulling the tongue rostrally will shift the epiglottis and hyoid apparatus rostrally and cause the palate to seem excessively long.

The laryngeal ventricles lie cranial to the vocal fold and caudal to the vestibular fold. Everted laryngeal sacculles are due to eversion, hyperplasia, and edema of the lining of the laryngeal ventricles. Everted sacculles appear as grayish, soft tissue masses protruding out at the ventral aspect of the rima glottidis.

Tracheal hypoplasia is a congenital stenosis of the trachea causing a narrowed tracheal lumen. Cartilagenous rings in dogs that have tracheal hypoplasia are rigid and often appose or overlap, while the dorsal tracheal membrane is narrow or obscured. Tracheal hypoplasia can be diagnosed by measuring the thoracic inlet to tracheal diameter ratio on a lateral thoracic radiograph. Non-brachycephalic breeds have a normal ratio of  $0.2 \pm 0.03$ . Brachycephalic non-bulldog breeds have a ratio of  $0.16 \pm 0.03$ , while bulldogs have a ratio of  $0.14 \pm 0.38$ .

Laryngeal collapse is the ultimate sequel of primary component abnormality in brachycephalic dogs. It can be classified into three stages. Stage one collapse is eversion of the laryngeal sacculles. Stage two collapse is weakening and medial collapse of the cuneiform

process, and stage three collapse is weakening and medial collapse of the corniculate process with loss of the dorsal arch of the rima glottidis. Laryngeal collapse is diagnosed and staged on sedated oral exam or on laryngoscopy.

### Therapy

Treatment of brachycephalic syndrome can be broken down into medical and surgical therapy.

Medical management for emergency treatment includes oxygen supplementation, fluid therapy, and active cooling if the animal is hyperthermic. Administration of anxiolytics and sedatives such as butorphanol (0.2-0.4 mg/kg) and acepromazine (0.01-0.05 mg/kg) is vital. Anti-inflammatory medications such as dexamethasone SP (0.14 mg/kg) can be administered to treat pharyngeal and laryngeal edema. Long-term medical management should focus on weight loss, restricted exercise, and providing the pet with a cool, shaded, and ideally air-conditioned environment. Neck leashes should be avoided and animals should be walked during the cooler hours of the day, such as at dusk and dawn.

### Emergency management of boas

Drug	Dosage
Butorphanol	0.2-0.4 mg/kg
Acepromazine	0.01-0.05 mg/kg (to start)
Dexamethasone SP	0.14 mg/kg
Oxygen therapy	

Surgical management should be considered in cases that have failed medical management. Patients are high risk for anesthesia, especially on recovery and these surgeries should ideally be done as the first case of the day. Dogs should be preoxygenated and a rapid induction agent should be used. An oral exam is performed immediately after induction and the patient should then be intubated. Assessment and surgery should be performed during the same anesthetic episode.

Patients are positioned in sternal recumbency. Stenotic nares are widened using a #11 scalpel blade or a laser. A horizontal or vertical wedge of tissue is removed from the alar fold and the remaining fold is sutured with approximately 3-4 simple interrupted sutures using an absorbable suture such as 3-0 or 4-0 poliglecaprone 25. A punch alarplasty can also be performed in which a section of the alar fold is removed using a skin biopsy punch. Sutures are performed as described above. Bleeding can be copious during nares resection, but gentle pressure and suturing generally provide adequate hemostasis. It is important cosmetically to make the nares as symmetrical as possible.

A staphylectomy (resection of elongated soft palate) can be performed using Metzenbaum scissors and suture, a laser, or a vessel sealing device such as a Ligasure™. The elongated portion of the palate can be grasped using Allis tissue forceps or stay sutures and pulled rostrally. It is important to place saline moistened gauze sponges between the palate and the endotracheal tube (or use a laser approved endotracheal tube) if using a laser so that the laser does not burn the endotracheal tube. If Metzenbaum scissors are utilized, stay sutures are placed on the lateral aspects of the soft palate and the incision across the palate is started. Sutures are placed to appose the oral and nasal mucosa using a quickly absorbable suture material such as 3-0 to 4-0 poliglecaprone 25 in a simple continuous pattern. The elongated portion of the palate is resected and the remainder is sutured. Sutures are not necessary if the laser or Ligasure™ are used. Long Metzenbaum scissors as well as long thumb forceps (such as DeBakey) and needle holders are helpful when suturing.

Everted laryngeal sacculles are grasped using a long Allis tissue forcep or long thumb forceps (such as DeBakey) and resected at the base using either Potts scissors or long Metzenbaum scissors. It is important to avoid resecting the ventral portion of the laryngeal mucosa as scarring and laryngeal webbing may occur during healing. It is also important not to resect the vocal cords.

Post operatively, patients are monitored carefully on recovery and should be fully conscious and supporting their own head prior to extubation. Analgesia such as buprenorphine is provided for the first 12-24 hours and patients are discharged with an analgesic such as tramadol, if needed. Patients that are very anxious or vocal upon recovery may benefit from mild sedation. Patients that suffer severe laryngeal edema during recovery may require a temporary tracheostomy.

Animals are discharged 24 hours after surgery with an Elizabethan collar and instructions for feeding wet food and exercise restriction for 10 days. Dogs should be walked using a harness rather than a neck collar and walked during the cool times of the day. A weight loss plan should be instituted in obese patients.

As mentioned earlier, a number of studies have determined that a large portion of patients with BOAS also have some gastrointestinal tract signs. Owners frequently will report clinical signs such as ptilyism, regurgitation and vomiting when questioned. Endoscopy with biopsies has revealed gastritis and duodenitis in patients. While many patients will improve with airway surgery alone, specific treatment with medications may be indicated in severe cases or those that have persistent clinical signs after surgery. Medications such as omeprazole and sucralfate have been used successfully to treat refractory patients. The medications may be instituted before the BOAS surgery or shortly after.

### **Prognostic points**

Brachycephalic surgery has a low morbidity and mortality. Overall, 80-90% of patients have a good to excellent outcome. Patients with severe laryngeal collapse usually show significant improvement with resection of the nares, palate and sacculles, although clinical signs may not fully resolve and laryngeal collapse may progress. Patients with severe laryngeal collapse that do not respond to standard surgery may need a permanent tracheostomy.

### **Summary**

Brachycephalic syndrome is commonly seen in dogs such as Bulldogs, French Bulldogs and Pugs. Most of these patients present when they are middle aged although many have a life-long history of noisy breathing and exercise intolerance. Evaluation and surgical correction of the palate, sacculles and nares should be performed with the patient under general anesthesia. Careful monitoring during and after surgery is vital to ensure a smooth anesthetic recovery. Dogs have a good prognosis after brachycephalic surgery as long as they do not have advanced laryngeal collapse. Dogs that have clinical signs of gastritis and duodenitis can be managed with medications either prior to or after surgery. While many patients improve with surgical correction of their airway disease, patients with refractory gastrointestinal signs may benefit from medical management.

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