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“The Brachycephalic Obstructive Airway Syndrome”

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Brachycephalic obstructive airway syndrome; more than just a long soft palate.

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Brachycephalic obstructive airway syndrome (BOAS) is one of the many terms used to describe obstructive upper airway disease seen in brachycephalic dogs such as English Bulldogs, French Bulldogs, Boston Terriers Pekingese and Pugs though the problem is not restricted to the classically brachycephalic breeds and can affect other breeds such as Cavalier King Charles Spaniels and Staffordshire Bull Terriers. Brachycephalic obstructive airway syndrome results from a combination primary structural problems including elongated soft palate, stenotic nares, hypoplastic trachea, redundant pharyngeal folds, macroglossia and protruding ethmoid turbinates within the nasal choanae. Rarely enlarged tonsils can contribute to the upper airway obstruction. Over time and as a result of chronically exaggerated negative inspiratory airway pressures secondary problems can develop which exacerbate the upper airway obstruction. These primarily include varying severities of laryngeal collapse. An additional potential consequence of the chronically exaggerated negative inspiratory airway pressures is the development of gastrointestinal disorders predominantly gastroesophageal reflux and hiatal hernias resulting in chronic gastritis and vomiting.

The clinical presentation of dogs with BOAS varies greatly due to the variance in severity of the primary structural problems and the absence or presence of secondary problems. Dogs present with a combination of snoring, coughing, respiratory stertor/stridor, dyspnoea, regurgitation / vomiting, exercise intolerance, cyanosis and syncope. The potential for a dramatic deterioration in respiratory function exists for all these dogs with the development of laryngeal collapse which can result in a dog acutely decompensating and progressing from snoring and respiratory stertor/stridor to an acute respiratory crisis and cyanosis. Consequently young dogs with mild clinical presentations should still be considered for surgical intervention to avoid the progression of the secondary problems, which can result in life threatening respiratory distress.

To maximise outcome all aspects contributing to the airway obstruction need to be addressed. Prior to surgery dogs should be evaluated to determine which aspects of the syndrome they suffer. The nares are evaluated during physical examination. In dogs with stenotic nares the nostril opening is small and the lateral wings of the nostril displaced medially (Figure 1). Surgical widening of stenotic nares is typically achieved by removing a vertical wedge of tissue from the wing of the nostril and alar fold. It is essential that this wedge extends appropriately caudal into the alar fold to achieve opening of the nares in the deep (nasal cavity) aspect as well as at the superficial opening (Figure 2.).

Laryngeal examination under general anaesthesia is used to evaluation palate length, laryngeal function, the presence or absence of everted laryngeal sacculles / laryngeal collapse, enlargement of tonsils or oral masses. The palate is considered elongated if it extends into the glottis or covers the ventral surface (Figure 3.). Plain lateral skull radiographs are useful for estimating length and thickness of the palate. Thickness of the palate needs to be estimated with caution, as minor rotation of the radiograph will artifically increase the apparent thickness of the palate. MRI provides a more accurate assessment of palate thickness (Figure 4.). An elongated soft palate is managed by standard palatoplasty or folded palatoplasty. A standard palatoplasty aims to shorten the palate to the level of the caudal aspect of the tonsillar crypt. Several techniques are described however sharp dissection (with or without the use of haemostats) and suturing the incised nasal hypertensive mucosa to the oral mucosa remains the mainstay of treatment (Figure 5.) A folded palatoplasty is a technically more challenging procedure that aims to concurrently shorten and reduce the thickness of the palate. This procedure is best suited to dogs with concurrent macroglossia and an overly thick as well as overly long palate.

Everted laryngeal sacculles are visualised as tissue masses within the region of the vocal folds, protruding into the rima glottis (Figure 6.) Everted sacculles are managed with simple excision. Extubation facilitates grasping of the sacculle which are then excised with long handled Metzenbaum scissors. Enlarged tonsils are a rare finding and appear to be predominantly a feature of Cavalier King Charles Spaniels. Enlarged tonsils are easily managed by performing a tonsillectomy. It is advisable to over sew the tonsilar crypt to control haemorrhage.

Laryngeal collapse, hypoplastic trachea, macroglossia, redundant pharyngeal folds and protrusion of ethmoid turbinates into the nasal choana all represent aspects of brachycephalic obstructive airway syndrome that cannot be specifically managed with surgery. It is estimated that approximately 50% of dogs presented for brachycephalic obstructive airway syndrome have a degree of laryngeal collapse. The diagnosis of laryngeal collapse is highly subjective and based upon observations during the laryngeal examination. The severity is graded from 1 to 3 with grade 1 laryngeal collapse the most mild in which eversion of the laryngeal sacculles has occurred with mild distortion of the cuneiform and corniculate processes, grade 2 the cuneiform process grasp...
and aryepiglottic folds deviate medially resulting in ventral obstruction of the glottis and stage 3 in which the corniculate process in conjunction to the cuneiform process and aryepiglottic folds deviate medially resulting in dorsal and ventral obstruction of the glottis. Dogs suffering grade 1 and potentially grade 2 laryngeal collapse respond to correction of the nares, palate and everted saccules. Dogs suffering grade 3 laryngeal collapse have an extremely poor prognosis and require a permanent tracheostomy. Hypoplastic trachea is most commonly seen in Bulldog and Boston terrier breeds. These breeds have a relative hypoplasia of the trachea which is considered normal. Tracheal hypoplasia can not be managed surgically but as with laryngeal collapse dogs will still respond to correction of the nares, palate and everted saccules. Severe hypoplasia is assumed to be associated with a worse prognosis for improved respiratory function following surgery. The tracheal width is assessed on a lateral thoracic radiograph. For non bulldog breeds the ratio of tracheal width to the width of the thoracic inlet should be greater than 0.2. For bulldog breeds this ratio should be greater than 0.12 (Figure 7.).

As with hypoplastic tracheas, Bulldog breeds have a relative macroglossia. The degree of macroglossia is difficult to evaluate and is often overlooked as a component of the brachycephalic obstructive airway syndrome. It is extremely rare for macroglossia to be the primary cause of upper airway obstruction. Again no specific surgical management is available and the presence of macroglossia is not recognised to alter prognosis following surgery of the nares, palate and everted saccules. It is suggested that in dogs with marked macroglossia that a folded palatoplasty is more appropriate then simple excision of an overriding long palate. Macroglossia can be associated with muscular dystrophy diseases and hence represent a different disease process. This should be suspected if it is observed in a non Bulldog breed (Figure 8.).

Redundant pharyngeal folds are a consequence of pharyngeal conformation and cannot be managed surgically. Assessment for pharyngeal redundancy is subjective and is suspected in those dogs in which the glottis is difficult to visualise following palatoplasty. Some surgeons advocate excision of the subglottic fold if this is considered to be excessively large however this does not address the redundancy in the pharyngeal mucosa. The presence of ethmoid turbinates within the nasal choana is not at present routinely evaluated as surgical methods to address this aspect have not yet been refined or evaluated for efficacy.

Brachycephalic breeds are recognised to have the potential for an increased risk of anaesthesia associated death and consequently equal focus should be placed on confirming the diagnosis / surgery and anaesthesia regime. Despite this perceived risk good anaesthetic preparation, monitoring, and strategies for recovery can overcome the risks encountered. In general, anaesthetic induction is not associated with increased risk of death, it is the period during recovery following extubation that presents the greatest risk. Risks surrounding induction are reduced by use of a laryngoscope, good lighting and an assistant to hold the patient’s head elevated to facilitate intubation. Appropriate premedication to reduce anxiety additionally facilitates smooth and low risk induction. Premedication resulting in profound sedation should be avoided as rapid recovery following discontinuation of anaesthesia is required. Pethidine or morphine are appropriate premedication drugs, avoiding the use of acepromazine. Once intubated these patients have no additional risk compared to other breeds.

Recovery from anaesthesia presents the biggest anaesthetic challenge. The period between extubation and return of laryngeal function requires close supervision and strategies to manage the patient if acute respiratory obstruction occurs. A low stress environment is critical as anxiety increases oxygen demand and respiratory effort, which can exacerbate upper airway obstruction. Recovery in an oxygen cage can facilitate recovery however this is reliant on the patient’s ability to successfully ventilate. The use of facemasks can be problematic as these can increase patient anxiety. Passage of a nasopharyngeal tube prior to recovery allows delivery of oxygen to the oropharynx during recovery and is a simple and effective way to oxygenate a patient in a stress free manner (Figure 9.). For all anaesthetic events in brachycephalic breeds, facilities should be available to perform a temporary tracheostomy and place a tracheostomy tube (Figure 10.). Owners should be made aware prior to anaesthesia that this is a possible scenario. Fortunately for the majority of patients this is not required and if required is a temporary measure until complete recovery from anaesthesia has occurred. Improvement in respiratory function is considered good to excellent in approximately 85 to 95% of dogs following surgery (approximately 50 – 55% excellent). Complete evaluation of the patient facilitates identification of factors that could require additional management or alter prognosis. Early intervention is advised as this reduces the risk of the development of secondary problems, particularly laryngeal collapse, that can result in significant and rapid deterioration in respiratory function in addition to potentially reducing the prognosis for a good outcome following surgery. In addition to good to excellent improvements in respiratory function, approximately 90% of dogs with concurrent gastrointestinal complaints have resolution of these complaints following the airway surgery.
Figure 1. An example of stenotic nares (left nostril) in which the nostril opening is small and the lateral wings of the nostril displaced medially. The right nostril has had a vertical wedge rhinoplasty performed to open the nostril opening.

Figure 2. Appearance of nostrils following a vertical wedge rhinoplasty. It is essential that this wedge extends appropriately caudal into the alar fold to achieve opening of the nares in the deep (nasal cavity) aspect as well as at the superficial opening.
Figure 3. Overly long soft palate which extends into the glottis and covers the ventral surface of the glottis and epiglottis.

Figure 4. Lateral skull radiograph demonstrating overly long and thick soft palate. Caution is required with regards to interpretation of the thickness of the palate as rotation of the skull will artificially thicken the palate. The black line is across the width of the caudal aspect of the palate. Note that the palate extends to the larynx and occupies the majority of the caudal nasopharynx and oropharynx.
Figure 5. Appearance of oropharynx following excision of the caudal aspect of the overly long soft palate. Compare with Figure 3 how the glottis is now visible and the palate no longer extends into the glottis.

Figure 6. Evereted laryngeal saccules protruding into the rima glottis. These are easily excised with sharp dissection.
Figure 7. A typical tracheal width in a Bulldog breed. The tracheal width is assessed on a lateral thoracic radiograph. For non bulldog breeds the ratio of tracheal width to the width of the thoracic inlet should be greater than 0.2. For bulldog breeds this ratio should be greater than 0.12.

Figure 8. Dramatic macroglossia and hypertrophy of pharyngeal musculature in a Pomeranian with a two year history of respiratory distress. This is an atypical breed and potentially was suffering from a muscular dystrophy. Unfortunately the only management option was a permanent tracheostomy which carries a poor prognosis.
Figure 9. A nasopharyngeal tube in place for the recovery of a French Bulldog from anaesthesia. The tube is connected directly to an oxygen source and allows delivery of oxygen to the oropharynx during recovery. A simple and effective way to oxygenate a patient in a stress-free manner during the critical stage of recovery from anaesthesia.

Figure 10. Intravenous anaesthesia induction agent, laryngoscope, a range of endotracheal tubes and tracheosotomy tubes ready by the patient cage in event of acute respiratory obstruction during recovery from anaesthesia. A nurse directly monitors the patient until laryngeal function has returned. This preparation and level of anaesthesia monitoring should be considered routine for all brachycephalic anaesthesia events.