Complications of Upper Airway Surgery in Companion Animals

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KEYWORDS

- Brachycephalic airway syndrome • Laryngeal paralysis
- Tracheostomy • Laryngeal stenosis • Complications

Surgery of the upper airway is performed in dogs for the correction of brachycephalic airway syndrome and laryngeal paralysis and for temporary or permanent tracheostomy. Although technically simple to perform, upper airway surgeries can lead to the development of significant postoperative complications. This article reviews complications associated with common surgical conditions of the upper airway. It involves a discussion of brachycephalic airway syndrome and associated respiratory and gastrointestinal complications. It also covers laryngeal paralysis with a focus on unilateral arytenoid lateralization (UAL) and the complication of aspiration pneumonia. The condition of acquired laryngeal webbing/stenosis and potential treatment options is also discussed. Finally, tracheostomies and associated complications in dogs and cats are reviewed.

BRACHYCEPHALIC AIRWAY SYNDROME

Brachycephalic breeds, such as English and French bulldogs, the Boston terrier, pug, Pekingese, Shih Tzu, and boxer, have a shortened skull, resulting in a compressed nasal passage and altered pharyngeal anatomy. The compressed upper respiratory anatomy causes increased negative pressure during inspiration, leading to inflammation, deformation of pharyngeal tissues, and obstruction.[1–3] The primary components of brachycephalic airway syndrome include stenotic nares, elongated soft palate, and hypoplastic trachea. Secondary components, resulting from the increased negative pressure, include everted laryngeal saccules, laryngeal collapse, and everted tonsils, which further contribute to the increased airway resistance and obstruction. Dogs with brachycephalic airway syndrome typically present with clinical signs of stertorous breathing, inspiratory dyspnea, exercise intolerance, and collapse episodes.

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Dogs may also present with signs related to the gastrointestinal tract, such as difficulty eating, gagging, vomiting, and regurgitation.

Surgical treatment of brachycephalic airway syndrome is aimed at reducing airway resistance and alleviating obstruction. The components of the syndrome that are amenable to definitive surgical correction are stenotic nares, elongated soft palate, and everted laryngeal saccules. The most commonly performed surgical procedures are staphylectomy, nasal fold resection, and everted laryngeal saccule resection. Complications associated with nasal fold resection are relatively uncommon and may include dehiscence or severe suture reaction leading to revision.[1,2,4] More common complications seen after brachycephalic airway surgery are related to pharyngeal or laryngeal surgery and include excessive respiratory noise, staphylectomy dehiscence, regurgitation/vomiting, aspiration pneumonia, severe dyspnea, and perioperative death.[1–3] It is important to recognize that these patients are at a relatively high anesthetic risk. They already have respiratory compromise and an associated increase in vagal tone, making them prone to bradyarrythmias intraoperatively. Although postoperative dyspnea occurs in up to 20% of dogs undergoing staphylectomy,[3] sudden death prior to recovery is a less common complication.[2] A number of factors contribute to the development of dyspnea after surgery. Pharyngeal and laryngeal inflammation and edema secondary to surgical trauma may produce increased airway resistance. Many of these patients have some degree of laryngeal collapse that may be complicated by reduced pharyngeal and laryngeal muscle tone secondary to anesthesia.[3] Laryngeal collapse is a progressive condition characterized by loss of support of the laryngeal cartilages. While it has been reported in young brachycephalic dogs,[5] it is more commonly seen in middle-aged to older dogs with severe brachycephalic airway syndrome.[2,3,6] Progressive laryngeal collapse may contribute to an increased risk of complications in older patients, especially bulldogs, which undergo surgery for brachycephalic airway syndrome. In all cases, careful monitoring of the patient is critical to ensure that postoperative complications do not become life-threatening. In patients with moderate to severe dyspnea, temporary tracheostomy should be considered to bypass the airway obstruction. In fact, some authors suggest the placement of a temporary tracheostomy tube in all cases to allow the safest possible recovery.[7] In addition to providing an alternate airway, it allows the placement of a tracheal oxygen catheter and the provision of ventilatory support if necessary. As a way to prevent excessive airway swelling, most surgeons advocate the administration of fast-acting corticosteroids (eg, dexamethasone sodium phosphate, 0.1–0.25 mg/kg iv) immediately prior to surgery and continued up to 1 to 2 days postoperatively.[6–8]

The traditional staphylectomy procedure is performed with sharp excision followed by oral and nasal palatal mucosal apposition using absorbable suture material.[6] In an effort to decrease postoperative complications, other methods including carbon dioxide laser and electrothermal bipolar sealing devices have been used for soft palate resection.[9,10] These methods have the purported advantages of eliminating the need for suture and minimizing intraoperative hemorrhage. In a prospective trial comparing laser resection and traditional soft palate resection, no significant difference was found in clinical outcome with the 2 techniques, although a shorter operative time was reported for the laser resection group.[11] In comparing CO_2 laser resection and the bipolar sealing device, both had short operative times with excellent hemostasis and similar depths of tissue injury on histopathology.[12] While both techniques have been successfully used clinically, a distinct advantage over traditional soft palate resection with respect to postoperative airway complications has not been demonstrated.

Interestingly, postoperative gastrointestinal signs, such as vomiting and regurgitation, are also relatively common following surgery for brachycephalic airway syndrome, occurring in up to 18% of cases.[1,3,4] Many functional and anatomical abnormalities of the gastrointestinal tract have been described in brachycephalic dogs, including dysphagia, gastroesophageal reflux, hiatal hernia, pyloric stenosis, and cardiac atony.[4,13] In 1 study, a very high prevalence of gastrointestinal problems was identified clinically, endoscopically, and histologically in brachycephalic dogs presenting for upper respiratory problems.[13] Of the dogs that had endoscopic biopsies performed, over 98% had inflammatory lesions of the distal esophagus, stomach, or duodenum that were likely contributing to the functional gastrointestinal problems observed.[13] Additional information suggests that combining medical management of gastrointestinal disorders with upper respiratory surgery decreases the complication rate and improves the prognosis of dogs presenting for brachycephalic airway syndrome.[4] In these studies, the medical management for gastrointestinal disease included the use of omeprazole, cisapride, sucralfate, and corticosteroids, when appropriate. In our experience, treatment with cisapride (0.5 mg/kg po q8h) and omeprazole (0.5–1.0 mg/kg po q24h) along with an easily digestible gastroenteric diet for 2 to 4 weeks is beneficial in managing affected patients prior to surgery.

Effective client communication is essential to successful surgical management of brachycephalic airway syndrome, especially when performed on an elective basis. Owners must be made aware of the perioperative risks associated with anesthesia and airway surgery, with the treatment plan being tailored to the individual patient. Brachycephalic dogs with evidence of concomitant gastrointestinal disorders should be appropriately managed medically before or in combination with airway corrective surgery to improve prognosis and decrease the risk of complications.

LARYNGEAL PARALYSIS

Acquired laryngeal paralysis is a common disorder and an important cause of upper airway obstruction in middle-aged to older large and giant breed dogs, such as Labrador retrievers, Chesapeake Bay retrievers, great Danes, Irish setters, and Afghan hounds.[14–17] Congenital laryngeal paralysis is also recognized in certain breeds, including Bouvier des Flandres, Siberian husky, bull terrier, dalmatian, and rottweiler.[14] In acquired laryngeal paralysis, degeneration of the recurrent laryngeal nerves leads to neurogenic atrophy of the cricoarytenoideus dorsalis muscles and loss of abduction of the arytenoid cartilages. Potential underlying causes include neoplasia, hypothyroidism, trauma, and various neuromuscular diseases.[14,16–18] In the majority of cases, a specific underlying cause is not identified, and the condition is considered “idiopathic.” The clinical hallmarks of idiopathic acquired laryngeal paralysis are related to laryngeal dysfunction and upper airway obstruction, including loss of phonation, stridorous breathing, dyspnea, exercise intolerance, coughing, and gagging. Various treatment methods for laryngeal paralysis have been described, including bilateral arytenoid lateralization, UAL, partial arytenoidectomy, unilateral and bilateral ventriculocordectomy, and castellated laryngofissure.[14] These procedures all aim to alleviate the upper airway obstruction by relocating or removing obstructing laryngeal tissue.

UAL is currently the standard treatment for canine laryngeal paralysis.[15,16] UAL involves fixation of the arytenoid cartilage to the thyroid or cricoid cartilage using 1 or 2 strands of nonabsorbable suture material. Despite its acceptance by many as the treatment of choice for laryngeal paralysis, the reported complication rate with UAL is high, ranging from 10% to 58%.[15,16] Potential complications associated with surgery for laryngeal paralysis include continued dyspnea, stridor,

coughing, gagging when eating/drinking, failure of the surgical repair, and seroma formation.

Respiratory complications in the immediate postoperative period may be related to airway swelling from surgical trauma and can be minimized by having a detailed knowledge of the regional anatomy, practicing meticulous soft tissue handling, and avoiding inadvertent penetration into the laryngeal lumen. Perioperative corticosteroid administration (eg, dexamethasone sodium phosphate, 0.1–1.0 mg/kg IV) has been advocated to help reduce inflammation.[14] In our practice, 2 strands of 2-0 monofilament nonabsorbable suture are used. Excessive abduction of the arytenoids may contribute to the risk of postoperative aspiration pneumonia. Use of an assistant to observe per os the size of the laryngeal opening is described to optimize outcome.[19] Unfortunately, intraoperative visualization of the larynx requires removal of the endotracheal tube during general anesthesia, causing a temporary loss of airway control. In some cases, the arytenoid cartilages may be mineralized, and fragmentation of the cartilage can occur upon passage of the suture.[14] Breaking or pullout of the suture after surgery will lead to recurrence of the initial signs of laryngeal paralysis. In that case, arytenoid lateralization may be performed on the contralateral side.[14]

The most common complication following UAL is aspiration pneumonia, occurring in 18 to 28% of dogs after surgery.[15–17] Aspiration pneumonia results from inhalation of oropharyngeal or gastrointestinal contents into the respiratory tract, causing chemical, bacteriologic, and immunologic damage to the airways. Aspiration pneumonia is potentially life-threatening, with up to 23% of affected dogs not surviving to discharge.[20] In dogs that are successfully treated medically, pneumonia can significantly complicate recovery, leading to prolonged hospitalization, rehospitalization, and increased cost of care. The occurrence of this complication must be taken seriously, and decreasing the incidence of aspiration pneumonia should be a goal when considering the future of laryngeal paralysis treatment.

The risk of aspiration pneumonia is not linked to any one factor associated with UAL surgery. The cause of laryngeal paralysis, the complexity of laryngeal and pharyngeal anatomy and physiology, and the effects of surgical techniques and perioperative care must all be scrutinized to evaluate the risk of aspiration and develop a new direction for laryngeal surgery. Surgical technique does have an effect on postoperative outcome and the complication of aspiration pneumonia. It has been shown that bilateral arytenoid lateralization is associated with a significantly higher postoperative complication rate and higher incidence of aspiration pneumonia.[16] In 1 study, the complication rate following bilateral arytenoid lateralization was 89% and the mortality rate was 67%, with aspiration pneumonia being an important cause of death.[16] Bilateral arytenoid lateralization is thought to place dogs at higher risk of aspiration pneumonia by increasing the diameter of the rima glottis, allowing aspiration during swallowing. Coughing and gagging, especially after eating or drinking, are common sequelae of arytenoid lateralization and are probably associated with the minor incidents of aspiration.

A recently study prospectively evaluated esophageal dysfunction in dogs with idiopathic laryngeal paralysis compared to a breed- and age-matched control population of dogs.[21] The dogs were evaluated with esophageal studies including esophagrams in which oropharyngeal and esophageal function were observed under fluoroscopic guidance. Approximately 70% of dogs with idiopathic laryngeal paralysis were found to have some degree of esophageal dysfunction, with the cervical and cranial thoracic esophagus most notably affected. Furthermore, gastroesophageal reflux occurred in 62% of study dogs and only 6% of controls. Following initial evaluation, dogs with idiopathic laryngeal paralysis were treated with left UAL. The incidence of aspiration pneumonia among these

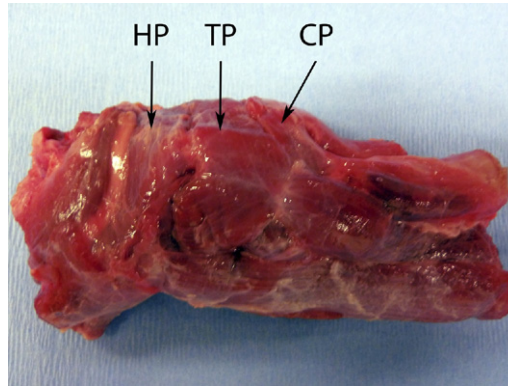

Fig. 1. Muscles of the canine larynx, lateral view. HP, hyopharyngeus m.; TP, thyropharyngeus m.; CP, cricopharyngeus m.

dogs was 18.5% and the degree of preoperative esophageal dysfunction was significantly higher in dogs that developed aspiration pneumonia.

The high incidence of esophageal dysfunction in dogs with idiopathic laryngeal paralysis may be related to the presence of generalized neuromuscular disease. There is an increasing body of evidence accumulating to support an underlying neuromuscular disease process involved in the etiology of acquired laryngeal paralysis.[18,22,23] Generalized neuromuscular disease that affects normal swallowing and airway protective mechanisms may significantly increase the risk of aspiration pneumonia. Affected dogs may have generalized signs of muscle weakness and associated gait abnormalities with deficits in segmental spinal limb reflexes consistent with lower motor neuron paresis.[18] Based on this information, it is recommended that all dogs evaluated for suspected acquired laryngeal paralysis undergo a complete neurologic examination prior to surgery and a thorough clinical history should involve an inquiry regarding clinical signs consistent with esophageal dysfunction. Discussion of the possible etiologies of acquired laryngeal paralysis, goals of surgery, and the risk of postoperative complications is an essential part of client education prior to surgery.

Degree of increase in glottal area is probably not the only aspect of surgical technique that is associated with the risk of aspiration pneumonia. The surgical approach itself for arytenoid lateralization should be considered, especially with respect to anatomy and physiology of the upper esophageal sphincter. Functionally, the upper esophageal sphincter is the intraluminal high-pressure zone that lies between the pharynx and cervical esophagus. The role of the upper esophageal sphincter is to prevent air from entering the digestive tract during inspiration, as well as to prevent esophageal contents from refluxing into the hypopharynx.[24] Anatomically, it is composed primarily of the cricopharyngeus and thryropharyngeus muscles (**Fig. 1**). The cricopharyngeus muscle arises from the lateral surface of the cricoid cartilage and inserts on the median dorsal raphe of the pharynx. It is responsible for constriction of the caudal-middle part of the pharynx. The thyropharyngeus originates from an oblique line on the outside lamina of the thyroid cartilage and inserts on the median dorsal raphe. It is involved in constriction of the middle of the pharynx. These pharyngeal constrictor muscles, along with hyopharyngeus, stylopharyngeus, pterygopharyngeus, and palatopharyngeus, are innervated by the nerves of the pharyngeal plexus. The pharyngeal plexus is composed of branches from the glossopharyngeal

nerve and pharyngeal branch of the vagus nerve.[25] The cricopharyngeus muscle makes up the caudal third of the functional upper esophageal sphincter. The thyropharyngeus muscle is the thickest of the three pharyngeal constrictor muscles and contributes to the cranial two thirds of the upper esophageal sphincter. These muscles are composed of both slow and fast twitch fibers, which enable them to maintain a constant basal tone and still quickly relax in response to a swallow or belch reflex.[24] The upper esophageal sphincter relaxes/opens during swallowing, vomiting, and eructation. As part of the normal swallowing reflex, the relaxed and open upper esophageal sphincter actively contracts as the pharyngeal peristaltic wave reaches the sphincter.[24]

After the occurrence of a gastroesophageal reflux event, the upper esophageal sphincter is the only remaining physical barrier against entry of the refluxate into the pharynx and potentially the larynx and airway.[24,26] In addition to the swallowing reflex, a number of other reflexes that augment the protective function of the upper esophageal sphincter have been identified. They include the esophago–upper esophageal sphincter contractile reflex, the esophagoglottal closure reflex, and the pharyngeal (secondary) swallows reflex.[26] Studies in people and animals have identified a strong relationship between upper esophageal sphincter pressure and esophageal intraluminal pressure and pH changes during reflux events.[26]

Interestingly, the thyropharyngeus muscle is routinely transected as part of the lateral surgical approach for arytenoid lateralization. The consequence of transecting this muscle on upper esophageal sphincter function has not been evaluated. It is possible that the trauma to this muscle impairs its function as a sphincter and increases the risk of aspiration after surgery. This is an important consideration, especially in light of the evidence suggesting a high incidence of underlying esophageal dysfunction in dogs with acquired laryngeal paralysis.[21]

In addition to the factors already described, general anesthesia alone places laryngeal paralysis patients at increased risk for aspiration. The reported incidence of gastroesophageal reflux under general anesthesia varies from 17% to greater than 50%.[27,28] These events are usually clinically inapparent when they occur in otherwise healthy animals. In approximately one fourth of the dogs that develop gastroesophageal reflux, the refluxed contents reach the pharynx in sufficient quantity to place the patient at risk for aspiration.[29] There may be ways that we can improve upon anesthesia and perioperative care protocols to decrease the incidence of aspiration pneumonia, especially since that is a time period of relatively increased risk. In a prospective clinical trial, the effects of 2 doses of metoclopramide on the incidence of gastroesophageal reflux were evaluated in healthy dogs undergoing elective orthopedic surgery.[29] In this study, use of high-dose metoclopramide (1.0 mg/kg bolus followed by 1.0 mg/kg/hr CRI) resulted in a 54% reduction in the relative risk of developing gastroesophageal reflux. A single retrospective study has evaluated the use of metoclopramide in dogs undergoing surgical treatment for laryngeal paralysis, suggesting that dogs receiving metoclopramide had a lower prevalence of aspiration pneumonia than did dogs that did not receive metoclopramide.[30] Additional studies are indicated to evaluate the effect of metoclopramide, both perioperatively and long-term, on the development of aspiration pneumonia in dogs treated for laryngeal paralysis.

ACQUIRED LARYNGEAL STENOSIS

Acquired laryngeal webbing and stenosis can occur following traumatic intubation, tracheal foreign body trauma, and iatrogenic tracheal mucosal injury. In veterinary patients, it occurs most commonly after bilateral arytenoidectomy or ventriculocordectomy (vocal

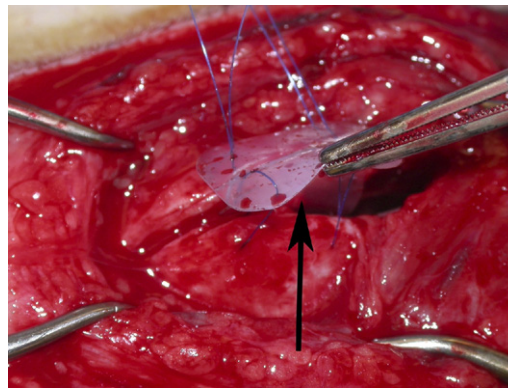

Fig. 2. Intraoperative photograph demonstrating the placement of a keel stent (*arrow*) through a ventral laryngotomy.

cordectomy).[31] Transluminal webs of mucosa-covered granulation tissue cause a progressive obstruction of the glottic lumen with associated dyspnea. Patients may compensate for as much as 60% decrease in lumen diameter with only mild dyspnea that remains unchanged for weeks.[31] Acute inflammation or mucus accumulation, however, can lead to sudden decompensation and life-threatening obstruction. The best treatment is to prevent stenosis with good surgical technique. Unfortunately, ventriculocordectomy is associated with substantial risk for the development of stenosing web formation and raises strong ethical concerns.[32] In cases of therapeutic arytenoidectomy or laryngeal trauma, surgical goals should include accurate anatomic reconstruction and direct mucosal apposition.[31]

Various surgical treatments for laryngeal webbing have been described. Unfortunately, mechanical dilation and simple surgical excision often result in rapid transverse regrowth of the scar tissue and recurrence of clinical signs.[31–34] Good success has been reported when the scar tissue is excised via a ventral laryngotomy and direct mucosal apposition over the defect is achieved.[32–34] This can be accomplished by elevating and advancing local mucosal flaps from laryngeal wall adjacent to the defects. The use of a temporary silicone "keel" type of stent inserted through the laryngotomy has been described to separate adjacent healing surfaces following web resection (**Fig. 2**).[31,33] The stent is soft enough to allow laryngeal motion without damaging tissue while it resists the transverse growth of granulation tissue, and is typically kept in place for 2 to 3 weeks.[31]

TRACHEOSTOMIES

Tracheostomies are performed when it is necessary to divert airflow directly into the trachea due to an obstruction in the more rostral sections of the airway. Tracheostomies can be used temporarily in the management of complications resulting from upper airway surgery, as discussed previously. Permanent tracheostomy may also serve as a more definitive palliative treatment for obstructive disease of the nasopharynx, larynx, or proximal trachea that cannot be addressed using other modalities. Unfortunately, tracheostomies themselves are not without complications.

Temporary tracheostomy (or tube tracheostomy) can be performed according to several previously described techniques, including transverse, vertical, and flap variations.[35] Transverse temporary tracheostomy is advantageous because no tissue

is removed from the tracheal wall and the cartilage rings are not disrupted.[35] Patients with temporary tracheostomy tubes must be monitored closely until the tube is removed. Obstruction or displacement of the tube can result in asphyxiation and rapid death. Complications following temporary tracheostomy are common and approach 50% in small animals.[36] The most common complications include gagging, vomiting, and coughing. Tube obstruction and displacement also occur somewhat frequently and are potentially life-threatening. Significant tracheal stenosis is uncommonly encountered, and routine healing of a transverse tracheotomy should result in less than 5% stenosis after 1 month.[37] Selection of tube type and size is important. Stenosis is more likely to occur with a tube that is too large or with a cuff that is overinflated, causing pressure erosion of the tracheal wall. The resulting lesions heal by the formation of granulation tissue and subsequent contracture.[38,39]

Patients with temporary tracheostomies must be monitored very closely until the tube is removed. The accumulation of mucus or blood obstructing the opening of the tube occurs commonly, causing moist stridor, dyspnea, and anxiety. Tube cleaning using sterile technique should be performed at least 3 to 6 times a day to avoid obstruction.[40] This may include sterile suctioning, the use of sterile cotton-tipped applicators, replacing the inner cannula of cannulated tubes, or completely replacing tubes that cannot be cleaned adequately. The placement of encircling sutures around the cartilage rings cranial and caudal to a transverse tracheotomy is helpful to dilate the site and facilitate rapid tube reinsertion.[35,40]

Permanent tracheostomy is performed according to previously described techniques.[35,41] While the majority of owners are satisfied with their pet's response after permanent tracheostomy in terms of improved breathing and increased activity,[42] it is important to be aware of potential associated complications.[42] Over half of animals with permanent tracheostomy lose their ability to vocalize normally, even when laryngectomy is not performed.[42] Surgery site swelling, excessive exudation, and partial dehiscence occur more often in obese animals.[41] Skin-fold occlusion of the tracheostoma is the most common reported long-term complication following permanent tracheostomy.[42] This can be minimized by carefully assessing and excising adjacent skin in animals with loose skin folds in order to leave a smooth even transition between the skin surface and tracheal mucosa at the anastomosis (**Fig. 3**).[35,40] While some stenosis of the tracheostoma is expected after permanent tracheostomy, the degree of stenosis can be minimized by practicing good surgical technique with minimal manipulation of the tracheal mucosa and precise mucosa to skin apposition.[42,43]

As with temporary tracheostomy, permanent tracheostomy patients must be monitored very closely after surgery for signs of obstruction and to provide appropriate care of the stoma.[40] Mucus secretion and accumulation around the stoma are expected in the short term, and the mucus can be gently removed with a saline-moistened sterile cotton-tipped applicator or gauze square. Care must be taken to avoid irritating the tracheal mucosa and disrupting the suture line, and a water-impermeable ointment (petrolatum) should be applied around the stoma to prevent secretions from adhering and crusting.[40]

Several recent studies have demonstrated a relatively higher complication rate associated with tracheostomies in cats. In 1 study, 87% of cats experienced complications associated with temporary tracheostomies.[44] Major complications occurred in 44% of the cats, with more instances of tube occlusion and tube dislodgement than has been reported previously. Another retrospective study of permanent tracheostomies described that 67% of cats had major complications, with postoperative dyspnea from mucus plug obstruction occurring most commonly.[45]

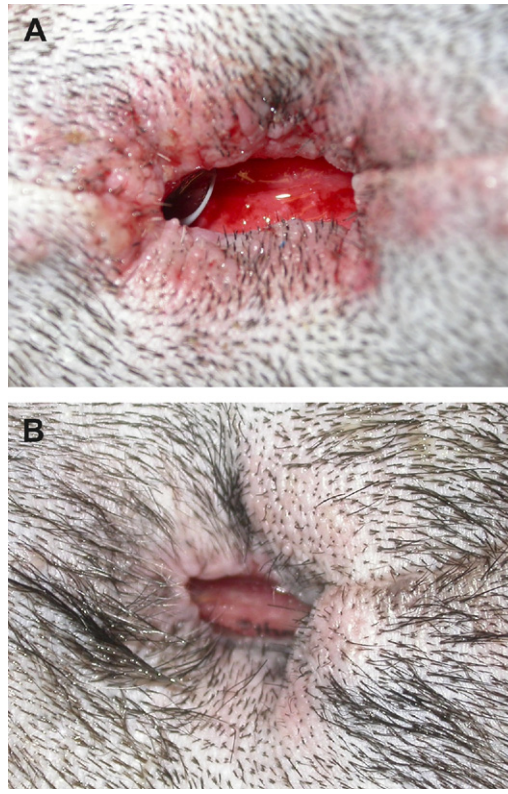

Fig. 3. Postoperative image of canine tracheostoma (*A*). Note the significant contraction of the same stoma and growth of the surrounding hair at a subsequent recheck examination (*B*).

Over half of the cats in that study died suddenly, either in the hospital or at home, with all documented causes of death being asphyxiation associated with mucus plugs. In cats, the high risk of mucus plugs causing occlusion of the respiratory tract is thought to be associated with the relatively small size of the trachea and tracheal stoma and the previously reported propensity of cats to develop thick airway secretions.[46] While successful treatment of upper airway disease with tracheostomy is possible in cats, owners must be made aware of the high risk of complications.

SUMMARY

Surgery of the upper airway has the potential to significantly improve patient quality of life but is associated with a relatively high incidence of complications. Surgical correction of brachycephalic airway syndrome carries the substantial risk of postoperative respiratory compromise in dogs that are inherently at high anesthetic risk and often have concomitant gastrointestinal disorders. Surgery for laryngeal paralysis is associated with a relatively high risk of aspiration pneumonia. That risk is likely related to the static increase in glottic diameter, the presence of underlying neuromuscular disease and esophageal dysfunction, as well as surgical trauma to the upper esophageal sphincter. The complication of stenosing laryngeal web formation is encountered commonly after ventriculocordectomy or

arytenoidectomy, and treatment must be aimed at restoring mucosal integrity and preventing regrowth of scar tissue. Temporary or permanent tracheostomies are useful in bypassing the upper airway and alleviating obstruction but are associated with their own set of complications that are especially prevalent in cats. When assessing surgical problems of the upper airway, the clinician must understand the potential complications associated with surgery, and the perioperative plan should focus on decreasing those complications. Furthermore, effective client communication is essential to the clinical decision-making process and helps in the successful management of complications when they occur.

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