The larynx has a number of functions, the most important of which are the optimization of airflow during inspiration, vocalization and prevention of aspiration of food or liquids during swallowing. Laryngeal paralysis is a common disease primarily affecting large breed dogs. It results from paralysis of the recurrent laryngeal nerve and functional loss of the cricoarytenoid dorsalis muscle, amongst others. These changes cause the inability of arytenoid cartilage abduction during inspiration. Congenital laryngeal paralysis has been reported in the Bouvier de Flandres, German shepherd, Rottweiler, Siberian huskies and other breeds. The majority of laryngeal paralysis cases are acquired. Causes of acquired laryngeal paralysis include trauma, neoplasia, iatrogenic causes such as radiotherapy and most commonly idiopathic, termed idiopathic laryngeal paralysis (iLP).

Etiology and pathophysiology
The recurrent laryngeal nerve and cricoarytenoid dorsalis muscle are actively responsible for opening the rima glottidis on inspiration and allowing flow of oxygen from the environment into the respiratory tract. The laryngeal musculature is also responsible for closing the rima glottidis when the dog swallows, allowing a secure fit between the glottis and epiglottis and preventing aspiration of flood or fluid. Understanding of this dual function is crucial in recognizing the pathological processes involved in the disease, as well as the complications associated with its treatment.

Traditionally, the pathophysiology of canine laryngeal paralysis has been thought to be similar to equine hemiplegia, the equivalent disease form in horses. A ‘distal back’ axonopathy was proposed because the long axons in the recurrent laryngeal nerve were relatively susceptible to “die-back.” However, current literature suggests that iLP is caused by a more systemic, generalized neuromuscular disease or polyneuropathy rather than one restricted to a single nerve or muscle.

Due to the emergency nature of these patients, a full neurologic exam is often overlooked or neuropathy is mistaken for weakness. A study by Jeffery et al examined patients presenting with laryngeal paralysis for any signs of a concurrent polyneuropathy. Age matched controls were compared to dogs with laryngeal paralysis. Based on electromyographic examination of the left thoracic and left pelvic limbs, pharyngeal and esophageal musculature as well as motor nerve conduction velocities of the left sciatic/tibial and right ulnar nerves, all dogs in the iLP group had neurological deficits and/or electromyographic changes associated with polyneuropathy, which were consistent with axonal degeneration. Thieman et al performed nerve and muscle biopsies on patients presenting for iLP. Histopathologic changes in both muscles and nerves from all dogs confirmed the diagnosis of polyneuropathy due to chronic axonal degeneration and nerve fiber loss. In some studies up to 100% of dogs treated for iLP have been found to have neuromuscular disease based on electrodiagnostic testing, physical examination and nerve and muscle histopathology.

Clinical diagnostics
Animals presenting with laryngeal paralysis may have a chronic history of respiratory problems or an acute onset. Clinical signs of laryngeal paralysis include tachypnea, increased upper respiratory noise, exercise intolerance, increased respiratory effort, cyanosis, hyperthermia and collapse. Acute crises are frequently seen during the spring and summer in dogs that exercised vigorously (such as jogging or running at the dog park). Many of these patients will present with signs of heat stroke and acute collapse. The most common breed affected by iLP is the Labrador retriever, although Golden retrievers and other large breed dogs can also be affected. Most patients are older with the mean age at presentation being 9 years.

Patient should have a full physical and neurologic exam performed at presentation, if possible. Three-view thoracic radiographs should be obtained to rule out neoplastic disease (metastatic or primary), aspiration pneumonia and megaesophagus, as well as other causes for dyspnea. In patients with megaesophagus, performing a barium swallow under fluoroscopy is helpful to assess swallowing dysfunction, which may influence prognosis and post-operative risk of aspiration pneumonia.

The diagnosis of laryngeal paralysis is made on oral examination, under a light plane of anesthesia. Sedatives and anesthetics affect laryngeal motion, and doxopram hydrochloride (1 mg/kg intravenously) can be given if respirations are weak or no laryngeal motion is seen. When performing a laryngeal exam, an assistant should alert the veterinarian when the patient is inspiring so that the timing of arytenoid motion and inspiration can be compared. In a normal animal, the arytenoids and vocal folds abduct during inspiration. In animals with laryngeal paralysis, the vocal folds do not abduct, and sometimes are adducted further towards midline (paradoxical motion) during inspiration. It is important not to confuse paradoxical motion with normal arytenoid function. Although the arytenoids may move, it is vital that abduction is seen during inspiration, rather than adduction. If one arytenoid abducts normally, while the other one is static, the paralysis is unilateral. Most patients presenting with clinical signs of laryngeal paralysis have bilateral paralysis. The arytenoids are often erythematous and edematous in patients with laryngeal paralysis.
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, using a harness, during the cooler hours of the day, such as at dusk and dawn.

Numerous surgical techniques have been described for the treatment of iLP including unilateral and bilateral arytenoid lateralization, castellated laryngofissure, partial laryngectomy, vocal fold excision with mucosoplasty, and bilateral ventriculocordectomy via ventral laryngotomy. The most commonly performed procedure is the unilateral arytenoid lateralization or “tie back.” This procedure involves an external approach to the larynx to allow one arytenoid cartilage to be pulled and fixed out of the airway using suture material. This has emerged as a preferred technique due to ease of procedure and good reported clinical outcome.

Emergency management of laryngeal paralysis

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<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
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<tr>
<td>Butorphanol</td>
<td>0.2-0.4 mg/kg</td>
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<tr>
<td>Acepromazine</td>
<td>0.01-0.05 mg/kg (to start)</td>
</tr>
<tr>
<td>Dexamethasone SP</td>
<td>0.14 mg/kg</td>
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<td>Oxygen therapy</td>
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Clinical outcome and prognosis

The most common complication of surgery for laryngeal paralysis is aspiration pneumonia. Several reasons for the risk of aspiration pneumonia after surgery have been postulated. These include: pre-existing esophageal disease related to generalized polyneuropathy and concurrent disruption of the para-recurrent laryngeal nerves; upper respiratory edema both from high pressure during dyspnea as well as iatrogenic damage during surgery and anesthesia; increased inspiratory pressure seen in dyspneic animals has been linked with increased gastro-esophageal reflux; and, since unilateral arytenoid lateralization results in deformation of the shape of the rima glottidis and holds it in a fixed position, the creation of a less airtight seal has been postulated to allow aspiration.

A study by Stanley et al. specifically investigated esophageal disease in iLP patients compared to aged matched controls. The results of blinded, subjectively assessed esophagrams showed dysphagia in the cranial esophagus in dogs with iLP. A significant difference was found in esophagram scores for dogs with iLP compared to controls and these findings were more predictive of aspirating after surgery than a full neurological examination. Two control dogs in the same study with relatively high esophagram scores developed iLP within 6 months after completion of the study. Although it is known that many patients present with esophageal dysfunction, it is unknown whether the surgical approach itself results in further damage to the nerves associated with the cranial esophagus and may increase the severity of dysphagia in some patients.

Other potential complications after surgery include breaking of the suture or fracture of the cartilage causing recurrence of clinical signs, continued coughing or gagging during eating or drinking, seroma formation and surgical site infection. Owners should also be made aware that dogs may suffer from weakness, ataxia and other neurologic signs, since this disease process does appear to be part of a more global neuromuscular disorder in many dogs.

The largest retrospective study evaluated the outcome of 140 cases and multiple different surgeries. Overall these patients suffered a 34.3% complication rate and 14.3% dogs died of related causes. Aspiration pneumonia occurred in 23.6% and seven dogs died of aspiration pneumonia > 1 year after surgery. Complication and mortality rate were increased by bilateral arytenoid lateralization surgeries, patient age, temporary tracheostomy placement, concurrent respiratory tract abnormalities, concurrent esophageal disease, postoperative megaesophagus, concurrent neoplastic disease, and concurrent neurologic disease.
A study of 40 dogs receiving unilateral arytenoid lateralization by a single experienced surgeon showed that 18% of patients suffered post-operative aspiration pneumonia; in this study 6/7 recovered. 56% dogs had minor complications; unresolved coughing or gagging, continued exercise intolerance, vomiting and seroma formation were the most common. 90% of owners reported an improvement in postoperative quality-of-life score. Median survival time was 12 months and only 1 dog was euthanized because of respiratory tract disease following surgery.

A similar study from another surgeon took retrospective data from sixty-two dogs over a three-year period. The perioperative complication rate was approximately 10%, while the success rate as judged by owners one year postoperatively was greater than 9%. Overall, clients tend to be very happy with the outcome after laryngeal paralysis surgery and patients do well.

Summary
Laryngeal paralysis is a complex disease most commonly affecting older large breed dogs, with Labrador retrievers being overrepresented. A diagnosis of laryngeal paralysis is made on oral examination under anesthesia. Multiple surgical procedures are available for the treatment of laryngeal paralysis. The unilateral arytenoid lateralization is the most commonly performed procedure and aspiration pneumonia is the most common complication. Dogs with laryngeal paralysis have a good prognosis and most have a very good quality of life after surgery.

References