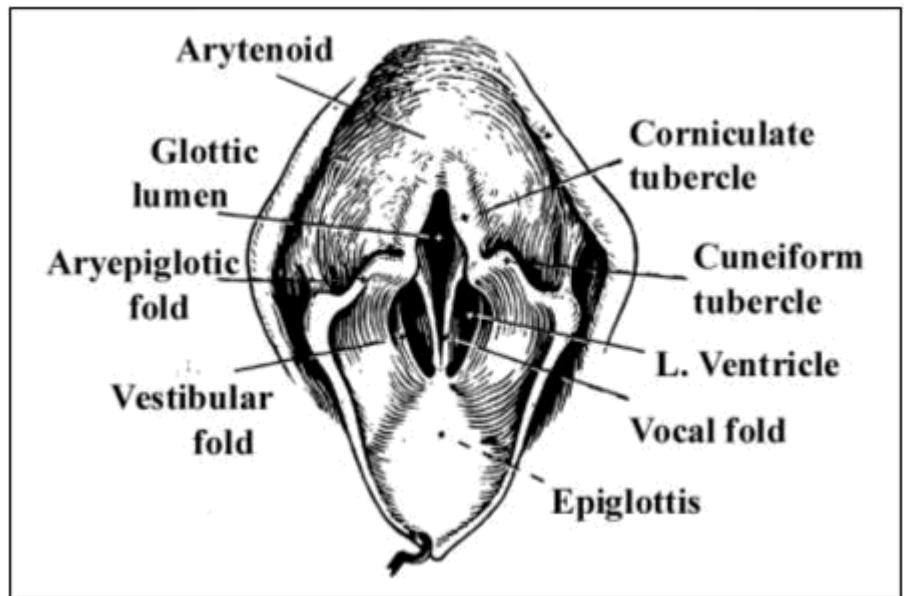


## Laryngeal Paralysis

Most of us know the larynx is commonly known as the “voice box” and is located in the throat. We know that laryngitis is a condition where one cannot speak, but other than that the larynx does not get much attention. It is a vastly under-appreciated organ. The larynx is not just where sound comes from; more importantly it is the cap of respiratory tubing. The larynx closes the respiratory tract off while we eat and drink so that we do not inhale our food. If we need to take a deep breath, the muscles of the larynx expand and open for us. The larynx is the guardian of the airways, keeping whatever we want to swallow out and directing air in.

Laryngeal paralysis results when the muscles that open the larynx (*abductor muscles*) do not work properly. This means no expanding and opening of the larynx for a deep breath; the laryngeal folds simply flop around, making lots of noise. This means that when a dog with LP needs a deep breath, he or she doesn't get one. This can create tremendous anxiety (imagine attempting to take a deep breath and finding that you simply cannot). Anxiety leads to more rapid breathing and more distress. A



respiratory crisis from the partial obstruction can emerge creating an emergency and even death.

Laryngeal paralysis does not come about suddenly. For most dogs there is a fairly long history of panting, easily tiring on walks, or loud breathing. Ideally, the diagnosis can be made before the condition progresses to an emergency.

Dogs with laryngeal paralysis demonstrate some or all of the following signs:

- Excess panting
- Exercise intolerance
- Voice change
- Loud breathing sounds, especially when breathing in
- Respiratory gasping or distress

The usual patient is an older large-breed dog; the most commonly affected breed is the Labrador retriever. The condition can occur in cats but is rare. The Bouvier des Flandres has a hereditary form of laryngeal paralysis that is able to affect young dogs.

### Is Laryngeal Paralysis Part of a Bigger Picture?

This question is still not fully answered. In one 1989 study, all dogs with laryngeal paralysis tested showed evidence of disease in long, large diameter nerve fibers in nerve biopsies from the rear legs. The suggestion was made that laryngeal paralysis represents “only the beginning” of a more widespread

neurologic degeneration. If this were true, one would suspect we would see a more obvious disease progression but, in fact, we do not most of the time. At this time acquired (non-congenital) laryngeal paralysis is largely an idiopathic (cause unknown) condition. We still can say that a dog with laryngeal paralysis is 21 times more likely to develop megaesophagus (enlarged esophagus), another neuromuscular disease, which causes frequent regurgitation and possibly also pneumonia.

The suggestion has been made that hypothyroidism (low thyroid function) may be a cause of laryngeal paralysis in some cases. This question is also not fully answered. We know that other neuropathies (nerve problems) associated with hypothyroidism will respond to treatment for hypothyroidism but laryngeal paralysis in a hypothyroid dog does not seem to respond as well. It may be coincidental that many older large breed dogs are hypothyroid and also have laryngeal paralysis or it may be that the laryngeal paralysis represents a state of neurologic disease that is too advanced to respond simply to thyroid hormone supplementation. In any case, dogs with LP should have the thyroid function tested by a blood test, and treated if the problem is identified.

### **Making the Diagnosis**

In order to determine if a dog has laryngeal paralysis, the larynx must be examined and this requires sedation. The level of sedation must be heavy enough to allow the larynx to be visualized but light enough for the patient to be taking some deep breaths. If the sedation is too deep for the diagnosis to be obvious, a respiratory stimulant called Dopram® (doxapram hydrochloride) is given intravenously to stimulate several deep breaths so that the function of the larynx is clear. In a normal larynx, the arytenoid cartilages are seen to open and close widely. In a paralyzed larynx (LP) they just sit there limply while the patient breathes deeply.

If the patient is having a respiratory crisis when seeing the veterinarian, this diagnostic test can easily be followed by intubation (inserting a breathing tube down the patient's throat). This relieves the upper airway obstruction and the patient can breathe normally. Unfortunately, sedation must be maintained to keep the tube in place, so it can not be left in long term.

A newer technique of visualizing the larynx involves threading a very small endoscope down the patient's nostril. This is tricky but the benefit is that sedation may not be required in some cases. The downside is that specialized equipment is needed and the patient may not be cooperative.

### **Additional Testing**

There are some additional tests that are helpful in evaluating the patient with laryngeal paralysis. Chest x-rays are important in ruling out aspiration pneumonia (lung infection from inhaling food material through the non-functional larynx), megaesophagus (enlarged esophagus, which tremendously complicates LP), and obvious tumor spread. X-rays of the throat to rule out obvious throat tumor or foreign body are also helpful. Complete blood testing including thyroid tests should also be included in the work-up.

### **The Crisis**

If laryngeal paralysis is not treated, a respiratory crisis can emerge. In this situation, the patient attempts to breathe deeply and simply cannot, creating a vicious cycle of anxiety and respiratory attempts. The laryngeal folds become swollen making the obstruction in the throat still worse. The patient's gums become bluish in color from lack of oxygen, and the patient begins to overheat. If the lungs are injured due to lack of oxygen, fluid begins to flood the lungs and the patient begins to drown (as if the laryngeal obstruction wasn't lethal enough). Once it occurs, this fluid accumulation is very, very difficult to reverse.

The patient must be sedated, intubated and cooled down with water in order to survive. If fluid has not yet collected in the lungs, as soon as intubation is effected, the patient can breathe normally, oxygen can be administered and the crisis can be curtailed if it has not progressed too far.

But, of course, eventually the patient will have to wake up. Corticosteroids (anti-inflammatory steroids) can be used to reduce the swelling, but ideally one of several surgical solutions is needed.

## **Surgical Solutions**

The goal of surgery, whichever technique is used, is to relieve the airway obstruction permanently while maintaining the original function of the larynx (protection of the airways).

*Ventriculocordectomy (De-Barking)* - De-barking surgery has traditionally thought of as a surgical solution to a behavioral problem (though we do not recommend this treatment for barking), but it is also a fair treatment for laryngeal paralysis. The usual method involves extending a long “biting” forceps down the throat and biting out the vocal folds. Obviously anesthesia is needed to do this and the fact that the surgical area is the larynx makes normal intubation for anesthesia impossible. This means either using injectable anesthesia or placing a tracheostomy (cutting a hole in the throat lower down) and intubating through that.

Removal of the vocal folds, of course, also removes the patient’s voice, reducing barking to a whisper. The hole created by the absence of the vocal folds makes for a larger airway opening and is generally large enough to relieve the obstruction. Complications of this surgery include swelling and bleeding (which can cause obstruction in themselves, though, if a tracheostomy is placed any such obstruction is bypassed), and regrowth of a webbing of vocal tissue. An alternative technique involves approaching the larynx from the outside of the throat instead of down the mouth. This method is more difficult and time consuming but has less chance of the development of webbing. A tracheostomy, if done, is allowed to heal closed.

*Partial Arytenoidectomy*- Another surgical technique involves only biting out one vocal fold and also biting out the arytenoid cartilage on the same side. There is more bleeding with this technique and a tracheostomy becomes more desirable. Surgeries involving removing part of the larynx have been associated with a 30% mortality rate in laryngeal paralysis patients. For this reason, these first two surgical solutions for LP are not usually recommended.

*Laryngeal Tieback (also called Lateralization Surgery)* - This has probably become the most commonly performed surgery for laryngeal paralysis. It involves placing a couple of sutures in such a way as to pull one of the arytenoid cartilages backward. By repositioning one of the arytenoids, the opening of the larynx is changed (made larger). The chief complication of this procedure stems from the fact that only a few millimeters of position change in the arytenoids are needed. If the cartilage is moved too much, the larynx cannot properly close and aspiration pneumonia becomes a substantial risk. Commonly these patients have a persistent cough after eating or drinking. This surgery has been associated with a 14% postoperative mortality rate. Years ago, both arytenoids were tied back to create a still larger larynx, but tying off both cartilages in this way was associated with a 67% mortality rate so it is no longer done.

The April 15, 2006, issue of the Journal of the American Veterinary Medical Association published a review of 39 dogs receiving unilateral tieback as described above. Of these dogs:

- 18% developed pneumonia just after surgery. One of these 7 dogs was euthanized, the other six recovered with treatment.
- Only 2 dogs (5%) were confirmed to have developed pneumonia more than 6 months after surgery. One of these dogs had multiple episodes of recurring pneumonia.
- 28% had persistent coughing after surgery.
- 90% of owners felt their dog had improved life quality after surgery.

*Hammel, S.P., Hottinger, H.A., Novo, R.E. Postoperative results of unilateral arytenoid lateralization for treatment of idiopathic laryngeal paralysis in dogs: 39 cases (1996-2002) JAVMA 228 (8): 1215-1220.*

In summary, tieback is a drastic procedure for a drastic problem. Without the procedure, a dog with severe LP will not do well – they can't breathe. With the procedure, there is risk, but many owners are pleased with the outcome, even if it is a short term solution, and the patient eventually succumbs to aspiration pneumonia. If LP is mild, then surgery is often not recommended.

### *Castellation*

In this surgery, a square of the thyroid cartilage is cut (similar to a castle's turret's square behind which an archer might hide). This square is moved forward and reattached to create a wider laryngeal opening. A tracheostomy is frequently needed to protect from swelling right after surgery.

In June of 2001, the *Journal of the American Veterinary Medical Association* published a survey of complications in a group of 140 dogs receiving surgical treatment for laryngeal paralysis. A summary of the results is:

- Of the 140 dogs, 34% were Labrador retrievers and 80% were classified as large breed (>48 lbs).
- 82% were over 6 years of age.
- Dogs with underlying neurologic disease were 3 times more likely to die from complications associated with laryngeal paralysis.
- Factors that significantly raised the risk of dying were: increasing age, need for a tracheostomy, concurrent respiratory disease, concurrent neurologic disease, and the development of a megaesophagus.
- Overall 34% of dogs had some kind of complication from surgery. The most common complication was aspiration pneumonia (see below), which occurred in 23.6% of dogs at some point.
- Of the dogs that developed aspiration pneumonia, about 60% developed it in the first 14 days after surgery.
- After aspiration pneumonia, the next most common complication was respiratory distress which occurred in 5% of patients.
- Approximately 3% of dogs died during surgery or in the 24 hours following surgery.
- About 19% of the dogs in the study received temporary tracheostomies. Of these dogs, 40% had tracheostomies that were not planned and were put in as an emergency procedure. The other 60% of tracheostomies were planned as part of the laryngeal paralysis surgery. About half of the dogs that had tracheostomies had some kind of surgical complication, surprisingly more dogs died where the tracheostomy was planned vs. those where it was placed as an unplanned emergency procedure. (15 dogs had planned tracheostomies and 7 of them died, 11 dogs had emergency tracheostomies and only 1 died). This might have occurred because those with more severe LP were more likely to have a planned tracheostomy – the increased death rate was not necessarily caused by the tracheostomy.
- Approximately 8% of the original 140 dogs developed complications more than 1 year after surgery.

*MacPhail CM, Monnet E: Outcome of and postoperative complications in dogs undergoing surgical treatment of laryngeal paralysis: 140 cases (1985-1998). JAVMA 218(12): 1949-1955, 2001.*

### **Aspiration Pneumonia**

While only about 10% of dogs being evaluated for surgical correction of laryngeal paralysis already have aspiration pneumonia, nearly 25% will develop aspiration pneumonia at some point. Pneumonia is always potentially life-threatening and aspiration pneumonia is particularly difficult to clear since it involves large contaminated food particles in the lung. Broad spectrum antibiotics, fluid therapy and physical therapy are important tools but, sadly, the underlying condition that led to the original aspiration pneumonia is likely to produce future episodes.

## References

1. <http://www.veterinarypartner.com>