

Laryngeal hemiplegia – what’s new?

Exploring the advances made in the treatment of horses with wind issues

Laryngeal hemiplegia, or recurrent laryngeal neuropathy (RLN), is not uncommon in the thoroughbred, along with other large breeds of equines. Recent research has shown that all thoroughbreds have some pathological evidence of the disease, but it is only clinically important in a small percentage of horses. It is the primary reason for undertaking a ‘wind test’ evaluation as part of the pre-purchase examination, and is a frequent cause of respiratory noise and poor performance in racehorses. The exact cause of the condition is still elusive, but we do know it is a neurological disease affecting predominately the left nerves travelling to the larynx, hence the ‘neuropathy’ part of its name.

The recurrent laryngeal nerve exits the central nervous system near the larynx in the upper neck region, but instead of travelling a few centimetres to its destination it descends all the way down the neck, turns around and re-ascends before returning to the larynx. The distance travelled by the two nerves on either side is not symmetrical, with the left one travelling much further. The cause of the condition is likely to be related to this unusual anatomy and may explain the reason why we see the condition more commonly on the left side. External trauma to the nerve is also implicated in the disease and its position near the jugular vein can mean it is at a higher risk of damage from trauma or drugs that are incorrectly injected into the adjacent vein.

With the nerve failing, the muscles that it communicates with (innervates) also begin to undergo dysfunction and eventually become paralysed. One of these muscles, the Cricoarytenoideus dorsalis (CAD), is the large muscle that sits on the top of either side of the larynx and acts to pull the arytenoid cartilages of the larynx up and out of the airway (abduction) when the horse breathes in (Figure 1). If this muscle fails and/or becomes fatigued during



Figure 1: The fully functioning airway of the horse, with both arytenoid cartilages held up and out of the airway

exercise (e.g. towards the end of a race) then the arytenoid cartilage and the associated vocal fold will fail to be abducted (Figure 2). In addition, the high negative pressures created in the airway as the horse breathes in results in these structures being pulled even further in to the airway and causing an obstruction. This in turn reduces the volume of air reaching the lungs and thus decreases the athletic capabilities of the horse. The resulting turbulent airflow causes respiratory noise, which in some cases can be heard as a musical whistle. The condition is often progressive and in the early stages the clinical signs may become apparent only when the muscles are exercised for prolonged and sustained periods (e.g. long-distance races).

As the disease advances, in some cases only over a matter of months, the clinical signs may eventually be seen at much slower gaits and training of the horse may become difficult.

Diagnosis

Accurate diagnosis of the condition can be challenging in all but the most severe cases. In advanced cases of the disease the CAD muscle wastes away, in the same way our limbs muscles do if ever placed in a cast and not used for many weeks. This muscle wasting can be palpated through the skin, with the underlying skeleton of the larynx becoming more prominent as a result.

Endoscopic examination of the upper airway allows the veterinary surgeon to initially evaluate the presence and extent of any laryngeal paralysis. As this is a neuromuscular condition the use of sedative drugs should be restricted, as they can cause muscular relaxation and may make the condition appear worse than it actually is. When observing the larynx at rest it is very rare to observe completely symmetrical and synchronous movements of the left and right arytenoid cartilages and their associated structures. Patience is

required and time is spent observing a number of respiratory cycles to ascertain any dysfunction that may be present. Soon after a swallow the larynx will fully abduct, so squirting water down the biopsy channel of the endoscope can be useful to induce this activity. Equally, by making the horse inspire greater volumes of air the larynx will open more widely and occluding the airways for 30 seconds or more, or examining the horse immediately following exercise, can be beneficial.

We know that the disease is progressive and at the time of examination the degree of muscle dysfunction may not be advanced enough to see at rest. However, when fatigued by exercise the muscle may begin to fail and the clinical signs noticed. Exercising endoscopic examination has, therefore, become invaluable in cases of RLN to assess the function of the larynx more accurately.

Some cases that have an asynchronous larynx at rest, that in the past may have undergone surgery, may be found to have a fully functioning airway when exercised. On the other hand, some cases that appear functional at rest may fatigue with extended exercise and as a result surgical intervention can be undertaken sooner. Those individuals with mild forms of muscular dysfunction may



Figure 2: The airway of an RLN-afflicted horse with the left arytenoid cartilage (on right of picture) collapsed into the airway



Figure 3: A horse undergoing overground endoscopy during routine training

actually be coping with the exercise required of them and require more conservative interventions to complete the current racing season. Repeat examination at the conclusion of the planned racing season can then be undertaken to evaluate any progression of the condition. This keeps the horse racing as long as possible and allows major surgical interventions to coincide more with a planned period of rest.

Exercising examination also allows a more complete assessment of other upper airway structures and it is not unusual for concomitant conditions to be diagnosed, allowing a much more accurate prognostication and more thorough treatment regime instigated. Equally, some other forms of airway obstruction may be confused with RLN from the clinical signs alone. For example, diagnosis of the whistle-causing medial deviation of the aryepiglottic folds (MDAF) requires a very different treatment than RLN.

In the past, high-speed treadmill endoscopy (HSTE) was used, but the advent of overground endoscopy (OGE) means exercising endoscopic examination can be performed much more readily in the racehorse (Figure 3). The examination can not only be included in the horse's routine training schedule, with next-to-no-impact on the horse or the training schedule, but the horse can exercise in a way it is more accustomed to on routine surfaces and with a rider on its back.

Treatment

In mild cases of RLN removal of the vocal fold and the adjacent ventricle may be all that is required to alleviate the clinical signs of the disease, or at least allow the horse to complete a current racing season before repeat evaluation. This procedure is commonly known as a Hobday; named after one of the early pioneers of the procedure.

Traditionally this was performed through an incision (laryngotomy) under the neck and left open to heal gradually over the following few weeks. Transendoscopic laser resection of the vocal fold and ventricle, with the laser passed in the biopsy channel of the endoscope, has largely replaced this practice (Figure 4). In experienced hands, with carefully applied local anaesthesia and sedation, the procedure can be performed precisely



Figure 4: Transendoscopic laser surgery of the left vocal fold

» under constant visual guidance with very few, if any, post-operative demands or complications.

In more severe cases of RLN in which the muscular dysfunction results in severe, if not complete, airway obstruction then a tie-back (or laryngoplasty) procedure may be necessary. Although far from being an innocuous procedure, the principle of the surgery is simply to replace the function of the CAD muscle and permanently fix the arytenoid cartilage in a position of near full abduction.

This surgery was traditionally performed with the horse under general anaesthesia, but recent advances in sedation and local anaesthesia techniques have meant this can safely and conveniently be performed in some carefully selected individuals.

This negates the risk associated with a general anaesthesia and allows the arytenoid cartilage to be abducted with the upper airway in a natural position. Along with the use of newer suture materials, anchoring devices and suturing techniques; it is thought that the arytenoid cartilage may be more likely to maintain its position post-operatively and not 'lose abduction', which is a frequent occurrence following this surgery.

As mentioned previously, although the principle of the tie-back procedure is straightforward, the fact that the arytenoid cartilage is permanently held open can cause a number of problems.

A small number of horses will not cope with this and may develop difficulty swallowing. Food and water may also enter the airway, 'going down the wrong way', causing coughing and potentially leading to lower airway infections. In addition, the tie-back sutures are put under tremendous pressure with slippage and cut-through of the cartilage possibly occurring.

As a result, most arytenoid cartilages will become less abducted over the first six weeks following surgery, and complete failure is not uncommon, which may have an impact on the prognosis for future racing potential. It is not a procedure to be undertaken lightly and an alternative has been sought for many years.

Various methods of re-innervation of the CAD muscle have been attempted in the equine as well as other species, including humans, to varying degrees of success. Until recently, these techniques have been plagued by prolonged periods of time until muscle function is restored (up to 12 months) and eventual

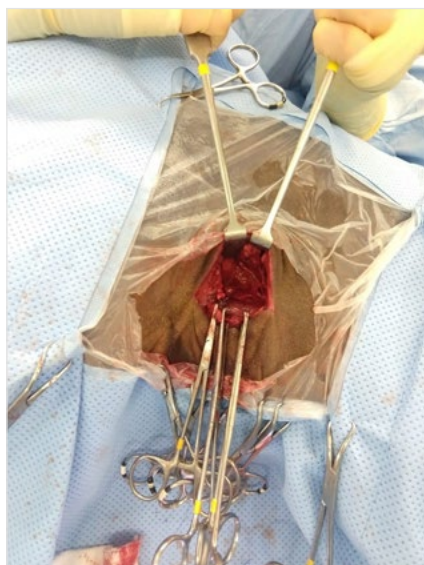


Figure 5: An intraoperative view of the nerve graft procedure

failure has been experienced. The technique has undergone a number of revision and has been refined, alongside surgeons working on similar human conditions, to now give us a technique that works more quickly, more reliably and does not seem to fail in the long term (Figure 5).

The method in use at the authors' hospitals involves taking donor nerves from a muscle of the neck adjacent to the larynx, and using a carefully developed technique of directly implanting them in the CAD muscle.

The technique requires specialist equipment to locate the tiny nerves, remove them and then implant them in the recipient muscle. The muscle that the nerves are obtained from is one of the muscles of the neck that is stimulated to work when the horse is exercising in order to stabilise the neck, head and upper airway.

It is innervated by a number of other nerves and its function does not appear to be affected by losing several nerve branches. The fact that the implanted nerve will then function only to stimulate the muscle when the horse is exercising is paramount to its use as a stimulus of the CAD. It means the arytenoid cartilage will abduct only when the horse exercises - when it needs to. At periods of rest and walking the cartilage will not fully abduct, similar to the scenario in the clinically normal horse. This means the complications associated with swallowing and food "going down the wrong way" will be avoided.

Although it appears to allow CAD

re-innervation much more quickly than previous techniques it can still take a number of months for full function of the muscle to return. A laser resection of the vocal fold and ventricle can help alleviate some of the clinical signs and airway obstruction in this period, but undertaking the procedure at the start or during a racing season would still be a risk. Early diagnosis of the condition is, therefore, important to try to identify the disease before it progresses too far and instigate the treatment before the clinical signs become too severe.

Good, and rapid, success has been achieved in a number of thoroughbred yearlings that were identified around the time of sales preparation. In addition, those horses that have slightly reduced abduction observed during a racing season, that can cope with more conservative procedures to get them through the season, may also be ideal candidates to have a nerve graft at the end of the season if future racing is planned.

The laryngeal pacemaker

Although the nerve graft appears to be promising the horse a more physiological treatment for RLN, if identified after the onset of clinical disease it may still mean a longer convalescence than the tie-back, which in some cases may be preclusive.

This convalescence may, however, be accelerated with the use of a laryngeal pacemaker. This is an implant that is placed under the skin, with an external magnetic battery unit, that directly stimulates the nerve used for re-innervation. It means that the CAD can be 'trained' independent of the rest of the horse. For example, when the horse is quietly resting in the box. The muscle, therefore, attains condition much more quickly and the horse may be able to return to work with a fully functioning larynx as quickly, or possibly quicker, than with a tie-back.

The pacemaker has been proven in the horse but its use in competition horses is, at present, restricted. However, it is designed in a way that would make it easy to identify horses with them inserted and ensure all power supplies are removed from the horse prior to competition. Ongoing research has also found other uses for similar pacemakers in other muscles of the upper airway and their use in other species is potentially limitless, with the racehorse providing clinicians and developers with the almost perfect testing ground for this technology.