The Equine Respiratory System
Understanding the basics of how horses breathe

The equine respiratory tract is a highly specialized organ system designed to move large volumes of air in and out of the lungs each minute. Any problem with the respiratory system’s structure or function can cause exercise intolerance and poor performance and negatively impact quality of life.

A GLORIOUS TUBE
A horse’s respiratory tract in some ways is nothing more than a glorified tube. Oxygen-rich air enters the nares (nostrils) and travels through the nasal passages (which are separated by the nasal septum), paired paranasal sinuses, and nasopharynx (the region extending from the nasal passages to the trachea). The nasopharynx is located above the soft palate, which is the anatomic extension of the roof of the mouth called the hard palate.

The horse’s soft palate is long, extending from the end of the hard palate to the base of the epiglottis. Because the epiglottis lies on top of the soft palate, “holding” it in place, horses are obligate nasal breathers. This means that a normal horse is not capable of breathing through its mouth. The larynx (voice box) demarcates the junction between the upper and lower airways and is located at the entrance to the trachea.

The epiglottis is one of several cartilaginous structures that make up the larynx. Other important larynx structures include the aryepiglottic folds, vocal cords, and glottic cleft (entrance to the larynx). Only when the epiglottis is laying flat on the soft palate can the air pass through the glottic cleft of the larynx to enter the trachea.

The air then passes down the trachea into the thorax (chest). Within the thorax, the trachea divides into two tubes called the chief bronchi, each of which leads to one of the lungs. The chief bronchi then subdivide into progressively narrowing tubes called bronchi and bronchioles. Lying at the end of the bronchioles are the alveoli— microscopic air sacs where the actual respiration process (the exchange of oxygen for carbon dioxide) occurs.

THE FATE OF INSPIRED OXYGEN
Oxygen in inspired air diffuses across the millions of alveoli’s thin walls and enter the bloodstream. The oxygenated blood in the lungs then circulates through the body and ultimately helps fuel a large number of activities, such as muscular contractions. Carbon dioxide, a “waste product” generated by the body, is carried back to the lungs in the bloodstream where it diffuses across the alveoli walls and is exhaled via the respiratory tract.

Although the respiration process appears outwardly simple, a number of nerves, muscles, cartilages, and other anatomic structures all need to function perfectly in concert to ensure air flows unobstructed to and from the alveoli, particularly during exercise.

WHEN THINGS GO WRONG
Respiratory tract disorders are one of the most common causes of performance-related problems in athletic horses, second only to musculoskeletal disorders.

Some of the frequently diagnosed respiratory tract problems in horses include:
- Infections (e.g., equine herpesvirus, equine influenza, strangles, pneumonia, *Rhodococcus equi* infection in foals);
- Dorsal displacement of the soft palate (DDSP, when the soft palate moves abnormally in an upward direction so the end of the soft palate rests above, instead of below, the epiglottis);
- Epiglottic entrapment by the aryepiglottic fold in the larynx;
- Laryngeal hemiplegia (roaring, left laryngeal hemiplegia), caused by paralysis of the left arytenoid cartilage and vocal fold, resulting in a failure to achieve full abduction of these structures during respiration;
- Exercise-induced pulmonary hemorrhage (EIPH, due to small vessels rupturing in the lungs); and
- Recurrent airway obstruction (RAO, heaves) and inflammatory airway disease (IAD).

How these different conditions impact the respiratory tract depends on their location. For example, roaring decreases the volume of air reaching the lungs with each breath, whereas infections or bleeding in the lungs can limit how effectively oxygen diffuses across the alveoli into the blood.

DIAGNOSING RESPIRATORY PROBLEMS
One of the most important diagnostic tools for assessing the respiratory tract is the endoscope. A veterinarian passes the flexible scope through the nasal passages to the nasopharynx. He or she can then directly evaluate the soft palate and larynx, where many of the abnormalities are found (i.e., DDSP, epiglottic entrapment, roaring).

Some horses require additional testing on a high-speed treadmill, videoendoscopy, or an “overground endoscope” that remains in place while the horse trains. Endoscopy is also a primary diagnostic tool for EIPH, as it helps the veterinarian identify blood in the trachea that is coming from the lower airway.

Ultrasound, radiographs (X rays), and even computed tomography (CT, where available) are all potentially useful tools to diagnose respiratory tract disorders.
TREATMENTS AND THERAPIES

The following chart outlines common respiratory disorders, treatment options, and possible outcomes:

<table>
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<tr>
<th>Respiratory Condition</th>
<th>Treatment</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Infection</td>
<td>Often will resolve without treatment or with supportive care alone. Some cases require antibiotics, intravenous fluids, and (rarely) hospitalization.</td>
<td>Usually good to excellent.</td>
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<tr>
<td>DDSP</td>
<td>Surgery (e.g., tie-forward, myectomy)</td>
<td>Approximately 80% of horses improve following surgery.</td>
</tr>
<tr>
<td>Epiglottic entrapment</td>
<td>Surgery</td>
<td>Very good: 80-90% of treated horses improve following surgery.</td>
</tr>
<tr>
<td>Laryngeal hemiplegia (roaring)</td>
<td>Surgery (e.g., tie-back)</td>
<td>With surgery the success rate varies from about 50-75%</td>
</tr>
<tr>
<td>RAO</td>
<td>A combination of environmental management and medications such as corticosteroids and bronchodilators are usually recommended.</td>
<td>No cure.</td>
</tr>
<tr>
<td>EIPH</td>
<td>There are no drugs currently approved for treating EIPH. Affected horses are often managed medically (off-label and with variable success) with drugs such as furosemide and devices such as nasal strips.</td>
<td>No cure.</td>
</tr>
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University of Florida veterinarians suggest that electroacupuncture might also be effective for treating roarers. The researchers electrically stimulated specific acupuncture points in 18 horses once weekly for three to seven sessions. They found the grade of laryngeal disease improved in all the horses after electroacupuncture therapy with no adverse side effects. Another option for treating roarers that is still in development is a technique called functional electrical stimulation, which involves stimulating the horse’s neck muscles to open his larynx. A handful of other studies have confirmed that increased omega-3 fatty acid consumption leads to increased blood plasma (the fluid part of blood) levels as well as red blood cells.

PREVENTION/CONTROL

Respiratory conditions can affect any horse at any age. For some conditions, such as roaring and EIPH, there are currently no known ways to avoid the problem. For other diseases, particularly RAO, owners are encouraged to consider the horse’s breathing zone—a 2-foot sphere around the horse’s nose from where he draws his breath—and minimize the amount of dust and debris in this zone. Housing environment is critical as well. Horses with IAD or RAO need as much pasture time and fresh air as possible. Also, remove the horse from the stable during clean out, use low-dust bedding, and use feeds with little dust.

Key References
2. Oke S. Diagnosing and Managing Upper Respiratory Tract Disorders. www.TheHorse.com/14969

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