theHORSE.com
YOUR GUIDE TO EQUINE HEALTH CARE

Sweet PDZ HORSE STALL ReFresher

The Equine Respiratory System

Understand basic anatomy and function of the respiratory system and what can go wrong

Overview

The respiratory system shuttles air to and from horses' lungs where respiration—the exchange of oxygen for carbon dioxide—occurs. This is a highly specialized organ system that can move large volumes of air in and out of the lungs each minute.1 At maximal exertion, a horse's maximal oxygen uptake is an is about 40 times greater than oxygen uptake at rest (and impressively higher than elite human athletes with maximal oxygen uptakes that are only six to eight times higher during exercising than at rest).[1] Any problem with the structure or function of the respiratory system can cause exercise intolerance, poor performance and negatively impact quality of life.[2]

Structure

The equine respiratory tract includes the nares (nostrils), nasal passages separated by the nasal septum, paired paranasal sinuses and guttural pouches, and nasopharynx (the region extending from the nasal passages to the trachea). The nasopharynx is located dorsal to (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, meaning air cannot enter the mouth to reach the trachea, because the soft palate blocks the airflow.

The larynx (voice box) demarcates the junction between the upper and lower airways and is located at the top of the trachea. The epiglottis is one of several cartilaginous structures that make up the larynx. The other cartilages that form the larynx are the cricoid, thyroid, and paired arytenoid cartilages. Other important structures of the larynx include the aryepiglottic folds, vocal cords, and glottic cleft (entrance to the larynx).

ANNE M. EBERHARDT

The horse's respiratory tract is designed to move large volumes of air in and out of the lungs.

The trachea extends from the larynx, down the neck, and into the thorax (chest). Within the thorax the trachea divides into two tubes called the chief bronchi. Each chief bronchi leads to one lung and, within each lung, further subdivides into narrowing tubes called bronchi and bronchioles, which end at the alveoli, microscopic air sacs located at the ends of the bronchioles.

Function

Except for the lungs, the respiratory tract is essentially a glorified tube through which air travels to and from the lungs. Air enters the nares, passes through the nasal passages (where it is warmed and debris is filtered) to the nasopharynx. Air then passes through the middle of the larynx via the glottic cleft and down the trachea to the alveoli.

In the alveoli, oxygen in the inspired air diffuses across the thin wall of the alveoli into the bloodstream, and carbon dioxide produced by the body's cells diffuses out of the blood and into the alveoli. The oxygenated blood in the lungs then circulates through the body.

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

When Things Go Wrong

Considering the complexity of the upper respiratory tract, it's no surprise that dysfunction is so common.[1,2] Some of the more frequently diagnosed respiratory tract problems in horses include:

- Infections (e.g., equine herpesvirus, equine influenza, strangles, pneumonia);
- Dorsal displacement of the soft palate (DDSP, when the soft palate abnormally moves in an upward direction so the end of the soft palate rests above, instead of below, the epiglottis);
- Left laryngeal hemiplegia (roaring) caused by weakness or paralysis of the left arytenoid cartilage and vocal fold, resulting in a failure to achieve full abduction of these structures during respiration and drooping of these structures into the glottic cleft;
- Epiglottic entrapment by the aryepiglottic fold in the larynx;
- Laryngeal hemiplegia (roaring, left laryngeal hemiplegia, caused by weakness or paralysis of the left arytenoid cartilage and vocal fold, resulting in a failure to achieve full abduction of these structures during respiration);
- Epiglottic entrapment by the aryepiglottic fold;
- 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 cross sectional area of the nasopharynx/

larynx, which decreases the volume of air reaching the lungs with each breath. In contrast, infections or bleeding in the lungs will limit how effectively oxygen diffuses from the inspired air, across the alveoli, and into the blood.

Diagnostic Tools

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 to evaluate the soft palate and larynx, as these are 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.

According to a team of Kentucky-based veterinary surgeons, using an ultrasound to look at specific muscles (such as the arytenoids cartilage muscle called the cricoarytenoideus lateralis) is a highly accurate and noninvasive tool to diagnose roaring.[4]

Treatment Options

Infections such as equine herpesvirus usually resolve after running their natural course. Others require systemic antibiotics, fluids, and possibly hospitalization.

In contrast, DDSP, epiglottic entrapment, and laryngeal hemiplegia are usually managed surgically. The exact procedure depends on the condition, but the goal is to open the airway. Success rates for these procedures are variable (the success rate for standard surgical correction of roaring is only 50–70%) and often depend on the horse's use.[2]

No drugs are currently licensed for EIPH treatment, and affected horses are often managed medically (off-label and with variable success) with drugs such as furosemide and devices such as nasal strips. RAO treatment combines environmental management and medications such as corticosteroids and brochodilators.[5]

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. However, the authors note long-term follow-up and a control group is necessary to confirm treatment success.[6]

Prevention/Control

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 two-foot sphere around the horse's nose from where he draws his breath—and minimize the amount of dust and debris in this zone. Provide as much pasture time as possible, remove the horse from its stable during clean out, use low-dust bedding, and use feeds with little dust.

REFERENCES

1. Oke, S. The equine respiratory system. TheHorse.com.
2. Oke, S. Diagnosing and Managing Upper Respiratory Tract Disorders. www.TheHorse.com/14969.
3. Sellnow, L. Anatomy and Physiology Part 11: Of Blood and Breath. www.TheHorse.com/8005.
4. Oke, S. Ultrasound exams for diagnosing roaring in horses www.TheHorse.com/18049.
5. Oke, S. Managing airway disease. www.TheHorse.com/15174
6. Oke, S. Roaring improved after electroacupuncture. www.Thehorse.com/15383.

Further reading and free horse health e-newsletter: www.TheHorse.com/Respiratory-Problems

Authored by Stacey Oke, DVM, MSc; reviewed by Nat T. Messer IV, DVM, Dipl. AVBP, Certified in Equine Practice.