



General meeting - October
5th, Sandra White - treats

The Equine Respiratory System
by: Stacey Oke, DVM, MSc
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The equine respiratory tract is so highly specialized for exercise that even the slightest deviation from normal can limit a horse's athletic career.

Erma Bombeck, the late, famous American humorist, once said, "The only reason I would take up jogging is so that I could hear heavy breathing again."

Well, Erma, you'd love horses! The respiratory tract of the horse, which moves extremely large volumes of air in and out of the lungs, is a highly specialized organ system that serves one primary function: to exchange oxygen for carbon dioxide. Compared to humans (whose respiratory tract is highly specialized for speech) and other mammals, a horse inspires and expires a staggering amount of air.

"At maximal exercise, a horse's upper airway is subjected to marked fluctuations in flow and pressure during spiration and expiration," explains Jon Cheetham, VetMB, PhD, Dipl. ACVS, from the Department of Clinical Sciences at Cornell University's College of Veterinary Medicine.

According to Cheetham, tracheal pressures ranging from -4905 Pa (pascals, which are a measurement of force per unit area; one pascal is a Newton per square meter) to 2746.8 Pa have been reported, as well as airflow velocities of up to 80 liters per second in horses exercising on a treadmill. To compare, the airflow of an average hair dryer is 40 L/s. "A horse's maximal oxygen uptake at maximal exertion is approximately 160 mL/kg/minute, which is about 40 times greater than their oxygen uptake at rest," says Cheetham. "This is far higher than an elite human athlete's maximal oxygen uptake, which is only about six to eight times higher at exercising compared to resting values."

With the exception of the lungs, the remainder of the equine respiratory tract is essentially a glorified tube--the other components of the respiratory system are, in some ways, considered ancillary and serve primarily as a conduit for the air to move between the environment and lungs. That is not to say that the other parts of the respiratory system are unimportant. In fact, respiratory system dysfunction is the second-leading cause of exercise intolerance and poor performance in athletic horses, following musculoskeletal disorders. Structural, functional, and infectious conditions can occur at any point along the respiratory tract.

But wait. Let's take a deep breath and start at the beginning.

Respiratory System Structure

The respiratory tract commences at the nares (nostrils) and includes the nasal passages separated by the nasal septum, the paired paranasal sinuses and guttural pouches, and the nasopharynx. The nasopharynx is the cavity located dorsal to (above) the soft palate and extends from the nasal passages to the larynx and start of the trachea. The soft palate is the anatomic extension of the hard palate, also referred to as the roof of the mouth. In the horse, the soft palate is very long: it extends from the termination of the hard palate all the way to the base of the epiglottis. The epiglottis, therefore, lies on top of the soft palate, making the horse an obligate nasal breather. That is, air cannot enter the mouth to reach the trachea because the soft palate blocks the airflow. Thus, the horse is the epitome of the proverb, "The nose is for breathing, the mouth is for eating."

| COMPARISON OF VARIOUS FLOW RATES (REPORTED IN LITERS PER SECOND) | |
|---|---------------------|
| Water over Niagara Falls (Canadian Horseshoe Falls) | 600,000 |
| Airflow velocities in exercising horses | 64-79 |
| Airflow generated by an average hair dryer | 40 |
| Airflow velocities in exercising horses | 64-79 |
| Airflow velocities in exercising humans | 4 |
| Molasses in January | Too slow to measure |

The epiglottis is one of several cartilaginous structures that make up the larynx (voice box). 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, the vocal cords, and the glottic cleft, which is the entrance to the larynx. The larynx is located at the back of the throat, at the top of the trachea. The larynx can be considered the “middle” of the respiratory tract, as it essentially serves as the dividing mark between the upper and lower respiratory tracts.

The trachea begins at the larynx and travels down the neck and into the thorax (chest). Within the thorax, the trachea divides into two tubes, the chief bronchi, each bronchus leading to one of the two lungs. Within each lung, the chief bronchi further divide and subdivide within the lungs. These tubes become narrower and narrower and are referred to first as bronchi, then bronchioles. Ultimately, the airways lead to the alveoli--microscopic air sacs located at the end of the bronchioles where gas exchange occurs. A classic example of the structure of the lungs is a bunch of grapes. If one were to hold a bunch of grapes by the largest stem, the stem would represent one of the chief bronchi, and it divides and subdivides to ultimate end at a grape, which represents the alveoli.

Respiratory System Function

As described above, the upper and lower airways can be considered a specialized passageway for the air to travel to and from the lungs--the functional unit of the respiratory tract where respiration occurs. Air enters the nares and flows through the nasal passages, where it is warmed and debris is filtered. The air then courses through the nasopharynx, passes over the epiglottis and through the larynx via the glottic cleft, before moving down the trachea, bronchi, and bronchioles to the alveoli.

There, the oxygen in the inspired air diffuses across the extremely thin walls of the alveoli into the bloodstream. There are millions of alveoli in the equine lung, and each is wrapped within a bed of tiny, thin-walled blood vessels called capillaries. The oxygen in the inhaled air delivered to the alveoli is, therefore, in very close proximity to the blood in the capillaries and simply diffuses across the alveolar and capillary walls into the blood, then into the red blood cells. Similarly, carbon dioxide diffuses out of the blood, into the alveoli, and is subsequently expired through the airways.

The driving factor for the diffusion of both oxygen and carbon dioxide is the existence of a concentration gradient. Since the blood that is pumped into the lungs is low in oxygen and a high amount of oxygen is present in the alveoli, the oxygen simply “flows” from an area of high oxygen concentration to an area of low oxygen concentration. The opposite is true for carbon dioxide. There are high concentrations of carbon dioxide in the blood pumped to the lungs (from systemic circulation), but there are only low concentrations in the alveoli. Thus, carbon dioxide flows down its concentration gradient, out of the blood, and into the air sacs of the lungs.

The oxygenated blood in the lungs is then pumped back to the left atrium and ventricle of the heart and is subsequently circulated throughout the body to oxygen-dependent tissues, such as exercising skeletal muscles.

While the process of respiration appears outwardly simple, the integrated function of many nerves, muscles, cartilages, and other anatomic structures is essential to ensure the unobstructed flow of air to and from the alveoli. This is particularly important in horses exercising at high speeds.

When Things Go Wrong

“Considering the complex anatomy of the upper respiratory tract and the high demands placed upon it by tremendous fluctuations in pressure within the upper respiratory tract, it is not surprising that respiratory tract dysfunction is so common,” comments Cheetham.

In fact, as mentioned previously, respiratory-related health conditions are the second-leading cause of poor performance in athletic horses. Something can “go wrong” at virtually any point in the respiratory tract. Some of the more common problems affecting the respiratory tracts of horses include:

- Respiratory tract infections (such as equine herpesvirus and strangles);
- Laryngeal lymphoid hyperplasia (also called pimples);
- Dorsal displacement of the soft palate;
- Nasopharyngeal collapse;
- Laryngeal hemiplegia (roaring);
- Epiglottic entrapment;
- Exercise-induced pulmonary hemorrhage (EIPH);
- Pneumonia;
- Pleuritis; and
- Inflammatory airway disease (IAD).

Of the above-listed disorders, dorsal displacement of the soft palate (DDSP) and laryngeal hemiplegia are thought to be the two most important causes of poor performance associated with the respiratory tract. It is currently estimated that 10-20% of athletic horses suffer intermittent or persistent DDSP, which describes the soft palate displacing upward above the epiglottis during exercise, creating an expiratory obstruction.

“This movement of the soft palate into the airway often results in vibration of the soft palate and an expiratory noise is audible. The decrease in performance associated with DDSP is due to this expiratory airway obstruction, a reduction in minute volume, tidal volume, and oxygen consumption,” says Cheetham. Minute volume is the amount of gas exhaled per minute, while tidal volume is the amount of gas inhaled and exhaled during one respiratory cycle.

“The exact cause of DDSP remains to be fully elucidated,” says Cheetham.

| PREVALENCE OF AIRWAY DYSFUNCTION | |
|---|--|
| Condition | Prevalence |
| Dorsal displacement of the soft palate (DDSP) | 10% to 20% of athletic horses |
| Laryngeal hemiplegia (roaring) | 5% to 8% of racing Thoroughbreds |
| Epiglottic entrapment | Approximately 1% to 2% of athletic horses |
| Exercise-induced pulmonary hemorrhage (EIPH) | As many as 87% of racing Standardbreds and 95% of racing Thoroughbreds |
| Inflammatory airway disease (IAD) | As many as 50% of racing Thoroughbreds and racing Standardbreds |

“We know that by experimentally blocking two of the nerves that control the tone of the palate and the position of the larynx we can induce DDSP,” he adds. “In young horses, pharyngeal lymphoid hyperplasia is also an important contributing effect. High airway pressure over the palate and increased local turbulence may also contribute to DDSP.”

Left laryngeal hemiplegia is caused by a weakness or paralysis of the left arytenoid cartilage and vocal fold, resulting in the horse’s failure to achieve full abduction of these structures during respiration. Instead, the arytenoid cartilage and vocal fold droop or hang in the lumen (middle) of the larynx. In turn, the diameter of the larynx during exercise is reduced and the volume of air that can pass through the horse’s larynx to the lungs is decreased. Left laryngeal hemiplegia is also called “roaring,” due to the classic sound emanating from the upper respiratory tracts of affected horses. The underlying cause of roaring is a degeneration of or damage to the nerve (the left recurrent laryngeal nerve) that innervates the dorsal cricoarytenoid muscle on the left side of the larynx. A veterinarian diagnoses this condition via endoscopic examination of the larynx, and he or she scores the condition according to a standardized grading scheme (Grade I to IV). For example, Grade I describes horses in which both arytenoid cartilages abduct completely and synchronously during respiration, whereas Grade IV describes horses with a left arytenoid cartilage that does not abduct during respira-

tion, but instead remains hanging at or near the midline of the larynx.

Diagnostic Challenges

Considering the clear difference in anatomic position of the soft palate relative to the epiglottis in normal horses as compared to horses with DDSP, diagnosis should theoretically be straightforward. But, like so many conditions in the horse, it's not that simple.

The soft palate is a dynamic structure that, in some horses, can relatively readily displace dorsally above the soft palate, but usually it only does so when subjected to high airway pressures (i.e., during exercise). Further, displacement of the soft palate often occurs only intermittently ... and usually not when the veterinarian is looking down the end of a scope! For these and other unidentified reasons, diagnosing DDSP continues to be clinically challenging.

Traditional diagnostic techniques include endoscopy either while the horse is at rest or exercising on the treadmill. In response to multiple concerns regarding the inability for endoscopy to accurately diagnose upper airway dysfunction, even on a high-speed treadmill, researchers developed portable endoscopy. While various forms of these portable endoscopes exist, the techniques for using any portable endoscope, also referred to as overground endoscopy, are essentially the same as with a traditional scope.

The fiberoptic portion of the scope is inserted through the horse's nasal passages to the level of the larynx. The scope has a lightweight light source for visualizing the structures of interest and a flushing system that enables the veterinarian to wash mucus and other debris from the tip of the scope. The scope is fixed to the horse's bridle to hold it in place while exercising. A small 2-kg to 3-kg box, containing a battery and electronics for recording the images, is affixed to the saddle, jockey's back, or cart/sulky/harness. The examiner also employs a remote system that can start and stop recording, flush the scope when needed, and allow real-time visualization. This technology is available in North America, and researchers are publishing studies supporting the ability to accurately diagnose airway dysfunction in horses exercising in their normal environments.

Take-Home Message

"The equine upper airway is highly complex and adapted for exercise. Airflows in the horse's airways are very high, which means that even a small abnormality can lead to a large decrease in performance," concludes Cheetham.

Establishing an accurate diagnosis using an endoscope with either a treadmill or an overground system is crucial to determining the most appropriate management for horses with airway dysfunction.

For more information about equine airway surgery or physiology, contact Dr. Jon Cheetham at jc485@cornell.edu.

This and other articles may be found at thehorse.com

Meeting Minutes

8/3/2010

Littlerock Fire hall

Capitol Riders Chapter, BCHW

Meeting called to order at 7:09 pm

Vice President Dean Hartman welcomed all.

Guest Cathe Linn introduced herself. Cathe works at the fire hall.

August 20 party moved to the Crowson's.

July minutes read, corrected, motion made to approve, seconded and passed.

Newsletter / Web - Chris said he hoped all were enjoying the newsletter. He will start using more articles from the web - de minimus use and attribution of the source should be all that is needed to avoid any copyright infringement. He has also been making updates to the web site.

Rides - Dean asked Tootie to talk about the upcoming rides. Tootie said that Keenes is 2 days for riding plus travel. No one has signed up yet.

Work Parties - Dean asked Jeff for comments. Jeff said there is an October 2nd work party on Capitol Forest cleanup at Sherman Valley Road on the left at the Tacoma Trail Cruisers clubhouse. People will drive around the forest and pick up garbage. 9 am start.

Ways and Means - Regarding garage sales, Dean said that Joyce and Don have not yet had a sale. Jeff said the Sheriff Mounted Patrol has a sale at the Ritchie Brothers site. The chapter can investigate working with them on parking. Joyce said the upper lot, with lanes, takes 5 to 6 people. Dean asked Jeff to talk with Barry and Carrie about who to talk to at the Mounted Patrol. Joyce said it is usually a 60/40 split on proceeds.

Social - Dean said the August 20th BBQ has been moved to the Crowson's due to Stave's recent illness. New directions will be provided.

Membership - Sandra said the chapter is now at 40 members.

Correspondence - Dean asked Jeff if the letter was written (per May 2010 minutes, a letter to DNR in support of a RCO RTP grant for adapting a trail in the vicinity of Margaret McKenny for winter equine use). Jeff said he will work on it.

Director's Report - Jeff said he is working on revisions to the chapter bylaws. They need to be submitted to BCHW at the September 25th Board of Directors meeting in Ellensburg.

Legislative - Dean asked Judy to speak. Judy said August 4th is the last day before Congress goes on summer break. We are looking at no special session of the Legislature. Judy mentioned the gas tax study and how it relates to the NOVA funding.

Old Business - Dean mentioned the dental clinics. The Veters gave or give credit to the hosts. The goal was to generate income. Sandra is working on scheduling and will know more in October.

Sandra will bring treats for the October meeting.

Tom asked about the chapter getting a card or plant for Steve. A motion to purchase a card and plant, or book, up to \$15 was made. Joyce said we need to make sure we always send a card or other recognition. The motion was modified to \$20, seconded and passed. Dean asked who should coordinate getting a card, flowers and so forth. Motion was made that when a member is having surgery or sick/injured, the chapter spend \$20 on a card and flowers.

Sandra and Tom said they can make custom cards. Tom and Sandra will bring samples to the October meeting.

A motion to adjourn was made, seconded and passed.

Meeting adjourned 8:10.

Respectfully submitted,

Chris Enrico
Secretary, Capitol Riders

RIDING RULES FOR OLD HORSEWOMEN

1. We DO NOT need to show up with our hair combed, make up on and wearing a clean shirt.
2. Moaning, groaning and complaining about aching muscles is perfectly acceptable, as is taking Motrin (or something stronger) prior to a ride.
3. Helping someone on or off the horse does not mean the rider is an invalid. It only means the horse got taller overnight.
4. No one will comment about how big someone's butt looks in a saddle.
5. Everyone will wait, patiently, while someone dismounts and adjusts equipment. Everyone will also wait, patiently, until that person remounts and is ready to move on...no matter how long that takes.
6. When a horse is acting up we will accept that the horse is just having a bad hair day and it is not the rider's fault.
7. Mentioning it is too hot, too dry, too humid, too wet, too buggy, etc., is considered self expression, not whining.
8. Wanting to be first, last, walk, or just stop does not mean the rider is a wimp. Sometimes it is necessary to teach a horse who is in charge.
9. We will take the time to discuss the important issues of the day like who is dating who, who is cheating on who and any other relevant information which needs to be passed on.
10. We will acknowledge that horses are very strange animals and sometimes for no reason at all we fall off of them. If this happens to any rider the other riders will ascertain that the person is okay and then not mention the incident to another living soul, especially husbands and significant others.
11. We will acknowledge, without apology, that riding more than 6 hours increases our grumpy level far more than any ego benefits we may get from riding longer.
12. Our horses are not fat. They are "big boned".
13. I need to keep this TWH riding mysterious and strange sounding. If everyone else finds out how much fun it is the price of the horses will go up and I won't be able to afford a dozen of them.

(author unknown)

AN OLD COWBOY'S ADVICE

- * Keep your fences horse-high, pig-tight & bull-strong.
- * Keep skunks & bankers & lawyers at a distance.
- * Life is simpler when you plow around the stump.
- * A bumble bee is considerably faster than a John Deere tractor.
- * Words that soak into your ears are whispered...not yelled.
- * Meanness don't jes' happen overnight.
- * Forgive your enemies. It messes up their heads.
- * Don't corner something that would normally run from you.
- * It doesn't take a very big person to carry a grudge.
- * You cannot unsay a cruel word.
- * Every path has a few puddles.
- * When you wallow with pigs, expect to get dirty.
- * The best sermons are lived, not preached.
- * Most of the stuff people worry about is never gonna happen anyway.
- * Don't judge folks by their relatives.
- * Remember that silence is sometimes the best answer.
- * Don't interfere with somethin' that ain't botherin' you none.
- * Timing has a lot to do with the outcome of a rain dance.
- * Sometimes you get, & sometimes you get got.
- * Don't fix it if it ain't broke.
- * Always drink upstream from the herd.
- * Good judgment comes from experience, & a lot of that comes from bad judgment.
- * If you get to thinkin' you're a person of some influence, try orderin' somebody else's dog around.
- * Live simply. Love generously. Care deeply. Speak kindly.

What Did YOU Do On Your Summer Vacation?

Capitol Riders members Tootie Crowson, Connie Bailey, Martha Kesting and Sandra White took a field trip to Emerald Downs on Sunday, September 26th and the day was, of course, all about horses! The gals were part of a group who rode at the Stockman's Coalition first poker ride a few weeks ago and Martha won four tickets to Emerald Downs and a behind-the-scenes tour with Dr. Everett Macomber. Connie also won a \$20 gift certificate which provided the petrol for our classy ride in her Jag. We four arrived bright and early and met Dr. Macomber in the cafe. We started our tour by walking to a vantage point for monitoring the horses as they are trained and we were up close and learned about the track itself.

Emerald Downs Tour 9/26/2010

Tootie, Connie, Martha & Sandra



Garlic French Fries...Ohhhh Yum!!!!

Then Dr. Macomber commanded a golf cart and we zipped around in short order. Dr. Macomber took us through what he does on any race day and we soon realized the complete set of checks and balances that are in place for the welfare of the horses both before and after they race. The highlight of what we saw was being taken out to the starting gate and being within arms reach of the horses as they were loaded into the chutes and then walking around the end to stand inches away from Mark, the "Starter", as he punched the handheld button.and the horses were off!! We had to quickly jump into the truck to get back around to the viewing point where the horses ran by, turned around and came back to the finish line to be detacked. Each

horse was watched for any lameness or anything that might concern Dr. Macomber.

We gals enjoyed watching about eight races and all the readiness that goes with them. We left having had some of the scrumptious garlic fries and we managed to get some shopping in as well. Yes, you guessed it --- Connie couldn't pass up the hats and decided to buy a great looking bonnet which meant Martha was able to wear the hat Connie brought from home. Tootie was sporting her cowgirl hat and Sandra managed to miss getting the must-wear-a-hat memo although it was close there for a couple of minutes when Connie was considering buying two hats.

The rain managed to stay at bay for the time we were at Emerald Downs. We all agreed on the way home that the day was wonderful! The only thing that would have made it better would have been if we had been able to have our riding partners there -- Dakota, Pedro, Holly and Nichi!

Calendar (partial) of Events for 2010 -

- Oct 2-3 Mossyrock Riders ride and playday
- Oct 5 General Meeting, Littlerock Fire Hall, 7:00 pm
- Nov 2 General Meeting, Littlerock Fire Hall, 7:00 pm
- Nov 6 Dental clinic, Ritz Duchesne
- Dec 3 BCHW, USFS & State Land Managers Meeting, Ellensburg
- Dec 4 BCHW Board of Directors Meeting, Ellensburg
- Dec 7 General Meeting, Littlerock Fire Hall, 7:00 pm



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