



### **Respiratory and Airway Health**

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### Objectives – Pulmonary Health

- 1. Convince you that the lung function is imperative to the equine athlete
- 2. Discuss the impact of lung disease on Thoroughbred racehorse performance
- 3. Report on the impact of barn environment on the equine airways

4. Describe strategies to combat poor air quality in barns



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## Why do we worry about the airway?





#### from

## Air to Muscles

### Mitochondria in Horse Muscles

Mitochondria use oxygen to provide energy to muscles.

The horse has more mitochondria in its muscles than most other mammals.

Oxygen consumption by equine muscle >>> oxygen delivery.

# Maximal Oxygen Consumption VO<sub>2</sub>max





- Human  $VO_2max = 80 ml/kg/min$
- Horse  $VO_2max = 200 ml/kg/min$

#### Heart + Lungs + Blood determine oxygen delivery



### Lung Function

- Gas exchange
  - Diffusion of oxygen from the lung into the blood
  - Diffusion of carbon dioxide from the blood into the lung
- Limited by:
  - Inflammation (IAD)
  - Bleeding (EIPH)



How much does a horse increase its breathing capacity from rest to racing?

- X 2
- X 10
- X 20
- X 30

Rest 12 breaths / min. Rate Tidal volume 5 I/breath Minute Ventilation 60 I/min To achieve this: Peak airflow l/s 5 Inspiratory pressure -2 cm H<sub>2</sub>O

### Rest to Exercise

12 < 120 breaths / min. Rate -5 < 15 l/breath Tidal volume 60 < 1800 l/min Minute Ventilation To achieve this: 5 < 75 /s Peak airflow • Inspiratory pressure -2 < -30 to - 40 cm  $H_2O$ 

#### Horse are unique!



srichinmoycentre.org/public\_home/es/centro/running\_pavitrata.jpg

travelimages.com/PictureOfTheWeek/8HorseGallop.jpg

## Horses are limited by their lung rather than their heart function.

#### Significance of Lung Disease

- A small change in lung function can diminish gas exchange and oxygen delivery
  - Not noticeable at rest
  - Influence racing performance
- Not been extensively studied in athletic horses







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**Inciting Factors** 

- Infectious
  - Viruses
    - influenza
    - herpes virus
    - rhinovirus
  - Bacteria
  - Parasites

- Environment
  - allergens
  - particulates/toxins
  - endotoxin
- Genetics
  - determines
    susceptibility

### Inflammatory Airway Disease

- Diminished racing performance
- Mucus
- Inflammatory cells
- +/- cough
- No fever
- Normal appetite
- Not "sick"
- Prevalence of inflammatory airway disease in racehorses approaches 33%



### Effect of tracheal mucus and tracheal cytology on racing performance in Thoroughbred racehorses

S. J. HOLCOMBE\*, N. E. ROBINSON, F. J. DERKSEN, B. BERTOLD<sup>†</sup>, R. GENOVESE<sup>†</sup>, R. MILLER, H. DE FEITER RUPP, E. A. CARR, S. W. EBERHART, D. BORUTA and J. B. KANEENE EQUINE VETERINARY JOURNAL



- Horses with a mucus score of 0 1 were twice as likely to place better compared to horses with a mucus score of 2 - 4.
- P = 0.0165 Odds ratio = 0.53
  95% confidence interval (0.32 0.89).



#### Mucus Score vs. Race Place



### What causes IAD?



- Environmental conditions
  - Aerosolized particles and gases (i.e. dust and pollution)
  - Fungi, molds, endotoxin, beta –D-glucan, bacteria, mite debris, inorganic dust (heavy metals), and noxious gases (carbon monoxide)

### Journal of Veterinary Internal Medicine



ACVIM Consensus Statement J Vet Intern Med 2016;30:503–515 Inflammatory Airway Disease of Horses—Revised Consensus Statement

L.L. Couëtil, J.M. Cardwell, V. Gerber, J.-P. Lavoie, R. Léguillette, and E.A. Richard

Early onset airway obstruction in response to organic dust in the horse

Christopher M. Deaton,<sup>1</sup> Laura Deaton,<sup>1</sup> Eduard Jose-Cunilleras,<sup>1</sup> Thea L. Vincent,<sup>2</sup> Alan W. Baird,<sup>3</sup> K. Dacre,<sup>4</sup> and David J. Marlin<sup>1</sup>

 Horses breathing dust had increased numbers of cells, increased amounts of histamine, and increased airway resistance within 20 minutes compared to horses breathing fresh air (at rest).

### Where is the dust?

### Particle mapping in stables at an American Thoroughbred racetrack

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### Local airborne particulate concentration is associated with visible tracheal mucus in Thoroughbred racehorses

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- Tracheal mucus was associated with
  - Stable
  - Stall
  - Month
  - Particulate matter





### **Highest Particulate**

- 1. Morning (cleaning and feeding)
- 2. Enclosed barns with closed doors
- 3. Feeding hay from nets hung outside the door
- 4. Continuously raking isles throughout the day

### Summary

- 1. <u>Pulmonary health is essential</u>. Small changes in lung function have consequences for race horses.
- 2. <u>Mucus matters.</u> Horses with no tracheal mucus placed better in races compared to horses with small to moderate amounts of tracheal mucus.
- 3. **Breathe clean air**. Tracheal mucus is a hallmark sign of inflammatory airway disease that is caused by environmental contaminants.