How do we define poor performance?

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Outline

- Poor performance definition
- Approach to poor performance
- Adaptation to exercise and training
- Factors limiting performance
- Causes of poor performance
- Clinical evaluation of the RT
- Exercise testing

Poor Performance Definition

- Decrease in performance level
  - Acceptable level of performance previously
- Exercise intolerance
  - Marked decrease in performance level
  - Not capable of training at previous level
- Unable to compete at expected level
  - Unproven horse
  - Expected level based on physical characteristics, genetic potential or training status
  - Training satisfactorily

Approach to poor performance evaluation

- Agreement with owner/ trainer on complaint
  - Decreased performance?
  - Exercise intolerance?
  - Expected level?
- Exercise intensity
  - High (Ex. Racehorses)
  - Moderate (Ex. Reining Horse)
  - Low (Ex. 4-H Horse)
- Fitness level






Approach to poor performance evaluation

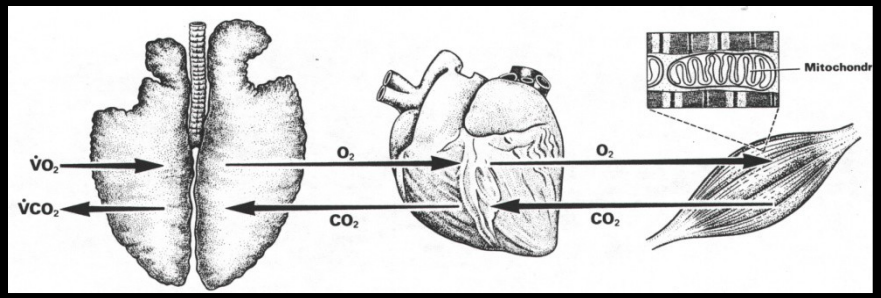
Exercise Intensity	Performance	Disease severity	Sensitivity to testing
High	↓ performance	mild	high
Moderate	↓ performance / exercise intolerance	moderate	moderate
Low	exercise intolerance	severe	mild

Approach to poor performance evaluation

- Compare individual's previous and current measurements
  - Objective performance criteria (running time, finishing position, etc.)
  - Physiological parameters (heart rate, respiratory rate, etc.)
    - Guide therapy
  - Clinical signs (nasal discharge, cough, respiratory effort, etc.)
    - Response to therapy
- Compare parameters measured over an extended period of time
  - Objective performance criteria
  - Physiological parameters
  - Clinical signs

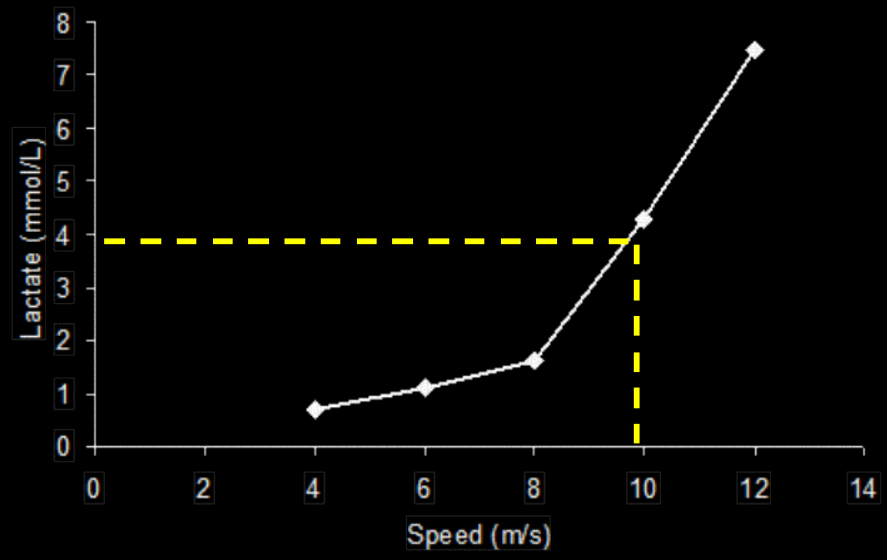
Adaptation to exercise

- Respiratory
  - V_E x 30, V_E =Expiratory Volume
- Cardio-Vascular
  - HR x 8-10, HR=Heart Rate
  - CO x 10, CO= Cardiac Output
  - [Hb] x 2, Hb=Hemoglobin



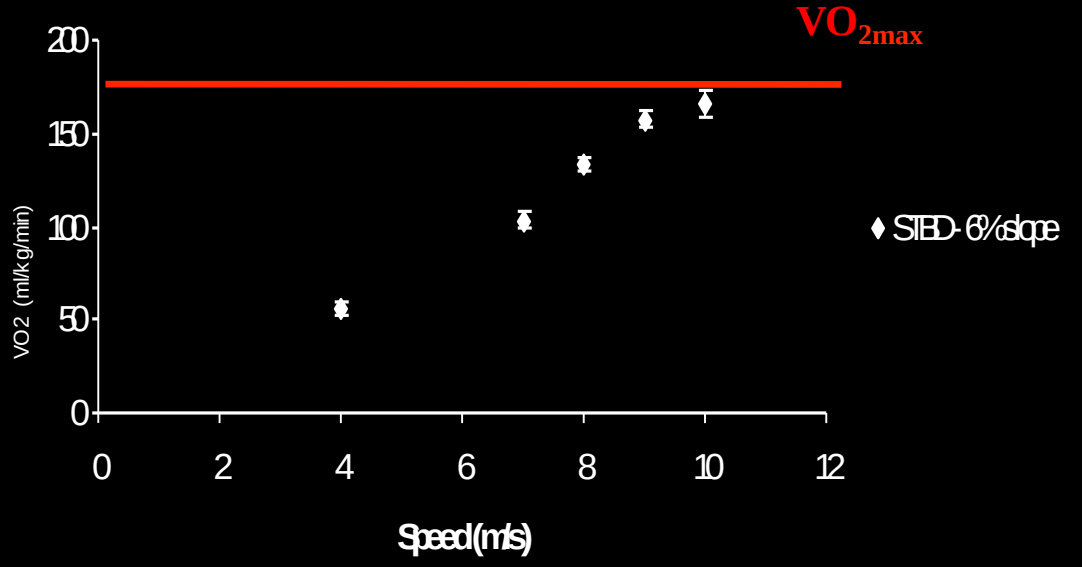
Adaptation to exercise

- Muscular
  - > 80 % CO during strenuous exercise
  - Lactate
    - Lactate is a by-product of glucose utilization without the presense of oxygen. With training, lactate levels are lower during strenuous exercise.



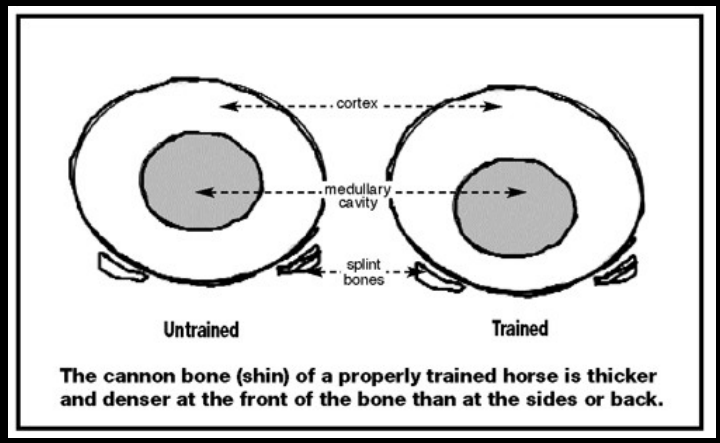
Adaptation to exercise

- VO_{2max} = 40 x VO_{2rest}
- VO_2 & HR increase linearly with exercise intensity up to a maximum
- VO_{2max} = maximum oxygen consumption
- VO_{2rest} = oxygen consumption at rest



Adaptation to training

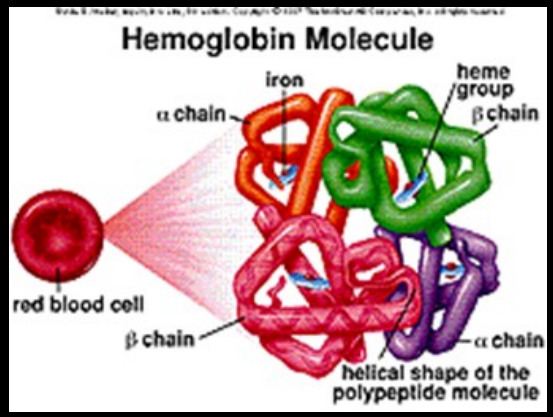
- Functional adaptations
  - Skeletal
    - Bones will respond to stresses applied to them
    - Where more force is applied, the bone responds by producing more bony tissue
    - See the picture to the right



The cannon bone (shin) of a properly trained horse is thicker and denser at the front of the bone than at the sides or back.

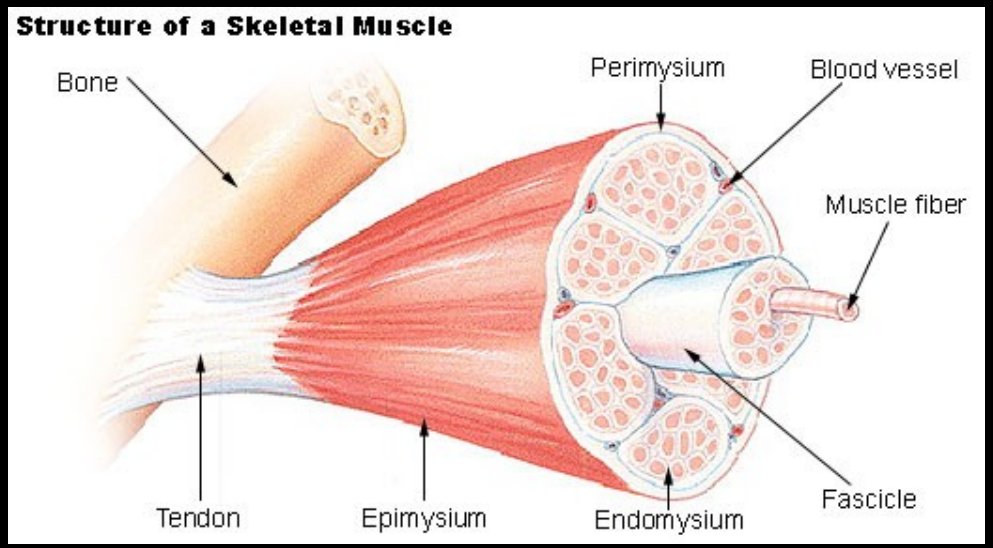
Adaptation to training

- Cardiac Changes
  - Maximum heart rate increases
  - Increased mass of heart (cardiac muscle strengthens)
  - Number of oxygen carriers (hemoglobin) in red blood cells increase by 15%



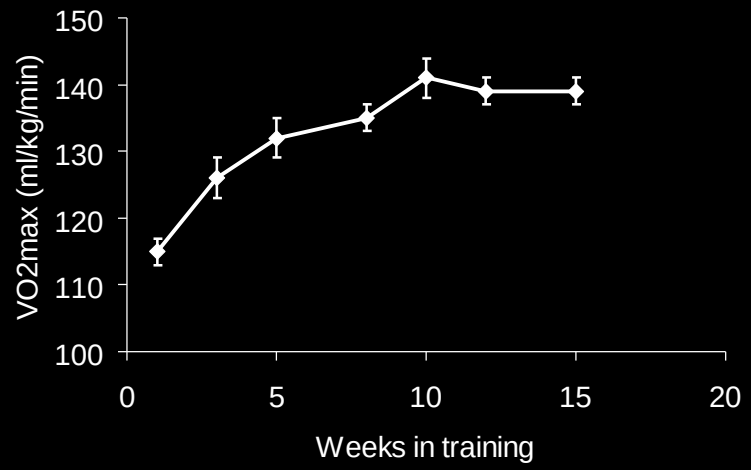
Adaptation to training

- Muscular
  - Muscle fibers increase in size
  - Increased amount of red blood cells delivered to muscle cells (increased capillary density)
- Respiratory
  - No change with training in maximum volume of air that can be breathed per minute



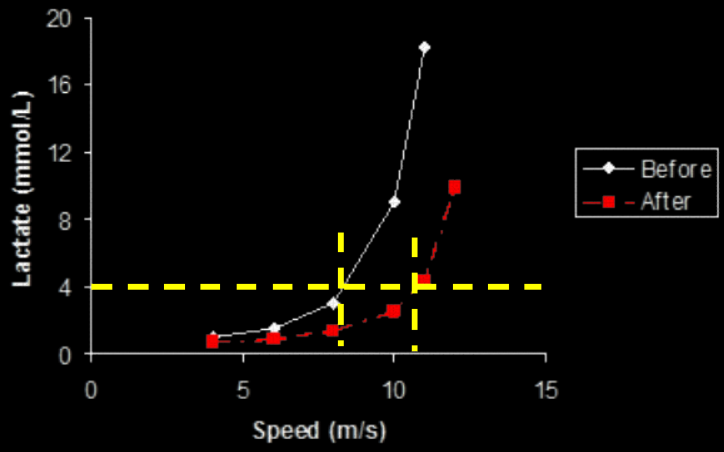
Adaptation to training

- VO_2max
  - Exercise capacity
  - Athletic potential
  - Training ↑ 10 – 25 %



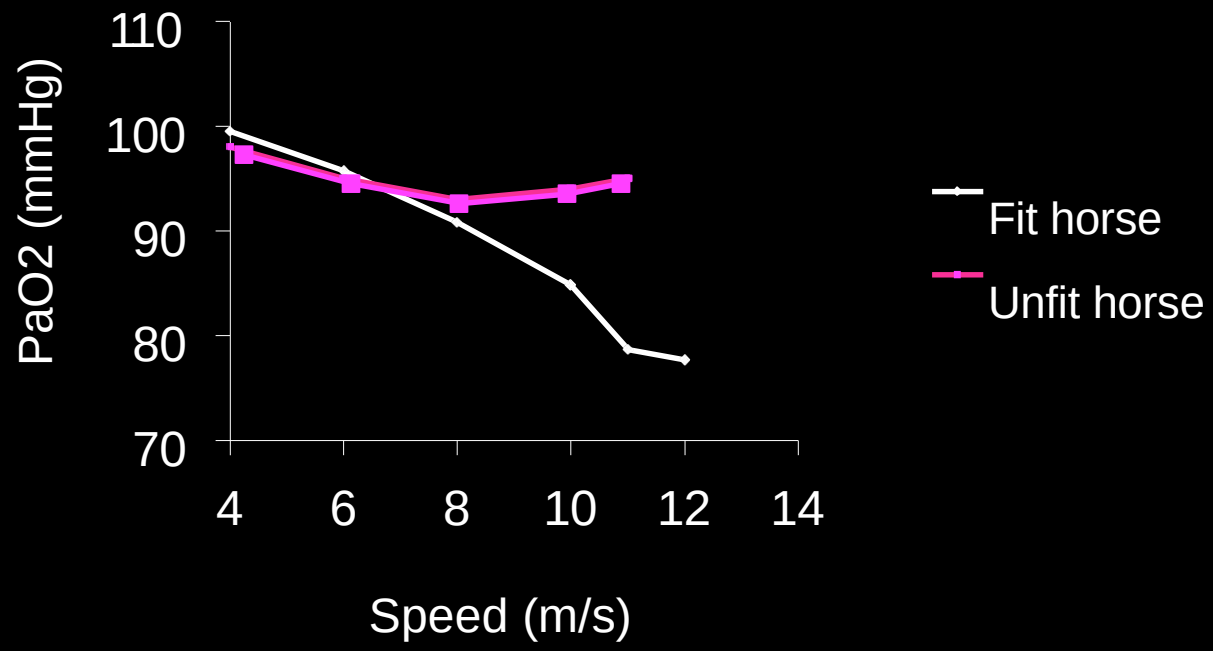
Adaptation to training

- Lactate
  - A product of cells using energy without the presence of oxygen
  - Causes “the burn” when exercising heavily
  - Once fitness is achieved, the amount of lactate produced decreases



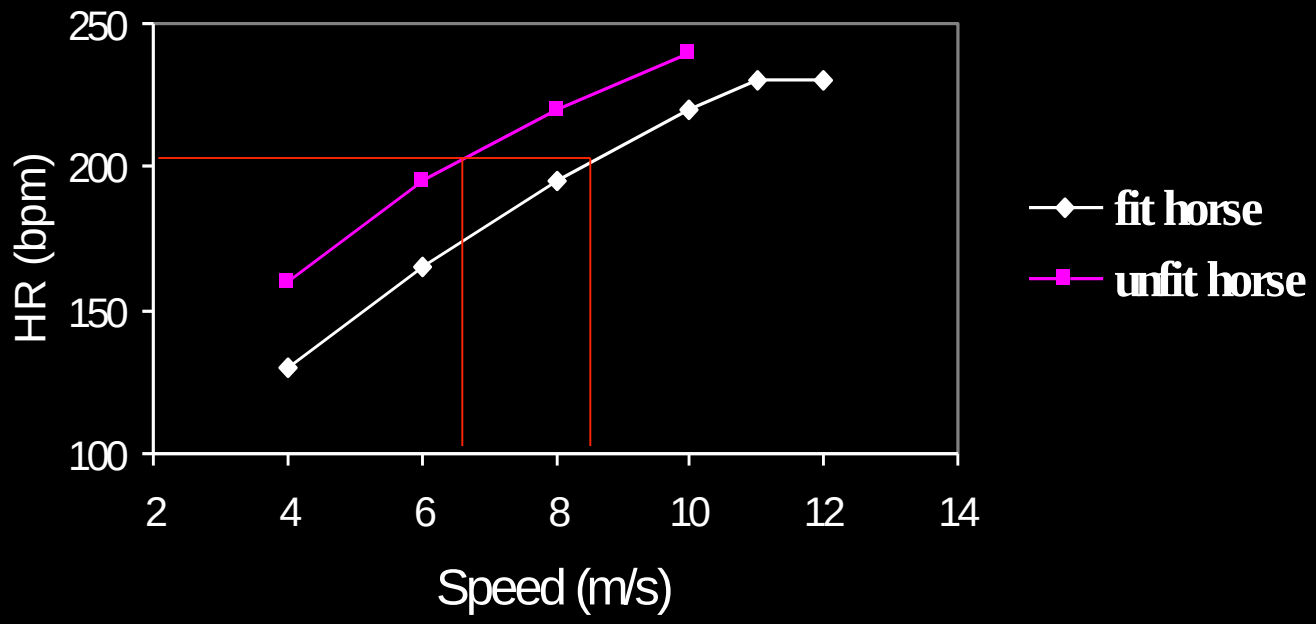
Adaptation to training

- Gas exchanges
  - Exercise
  - Training
  - PaO2 = partial pressure of oxygen
  - This value decreases with speed in the fit horse

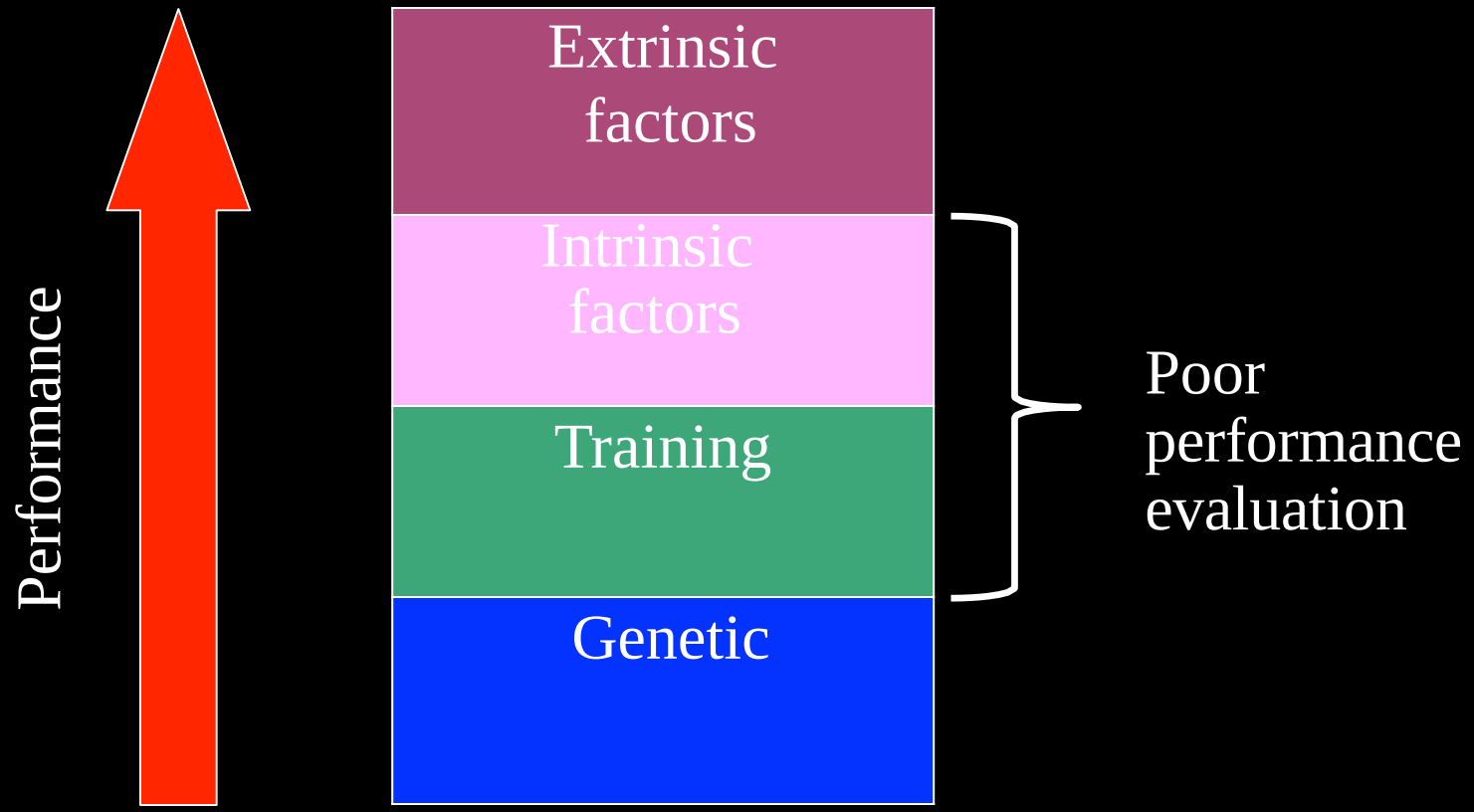


Adaptation to training

- Heart rate
  - Speed vs. HR
  - Speed @ VO_2max = speed @ V_{HRmax}
  - Training
  - V_{200}



Factors limiting performance



Factors limiting performance

Exercise type	Limiting factor	Respiratory disease severity	Body system
High intensity, short duration > 80% VO_2max	Oxygen delivery Lactic acid production	+	Respiratory
Moderate intensity, long duration 50-80 % VO_2max	Combustible, hyperthermia, dehydration	++	Cardiovascular Musculoskeletal
Low intensity, long duration < 50 % VO_2max	Fitness	+++	Musculoskeletal

Clinical evaluation of the RT

- Respiratory system
  - Upper airway endoscopy at rest

Arytenoid chondritis

Subepiglottic Cyst

Clinical evaluation of the RT

- Respiratory system
  - Lower airway endoscopy post-exercise

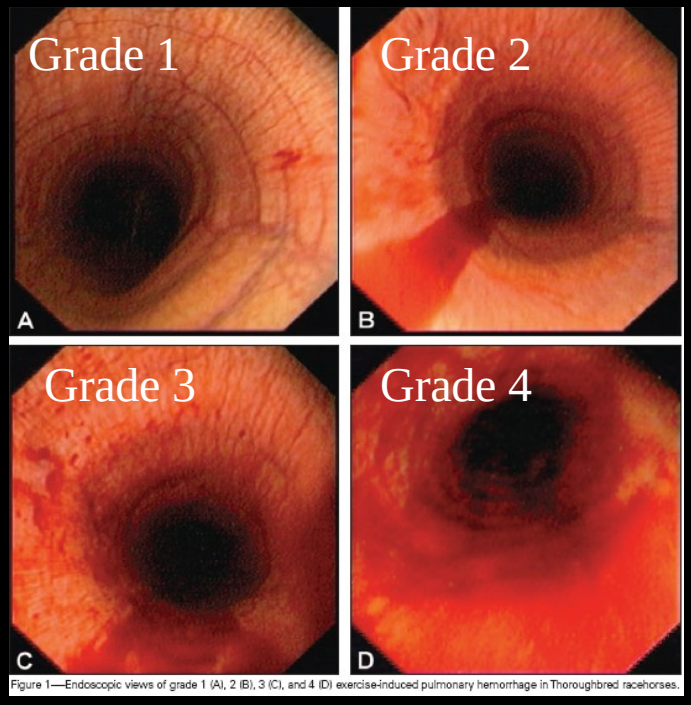


Figure 1—Endoscopic views of grade 1 (A), 2 (B), 3 (C), and 4 (D) exercise-induced pulmonary hemorrhage in Thoroughbred racehorses.

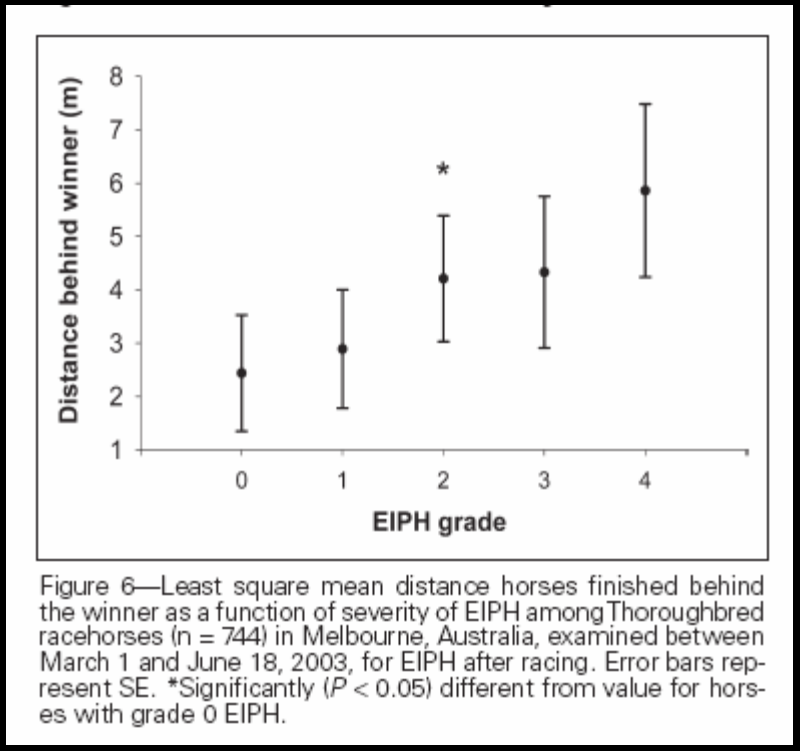
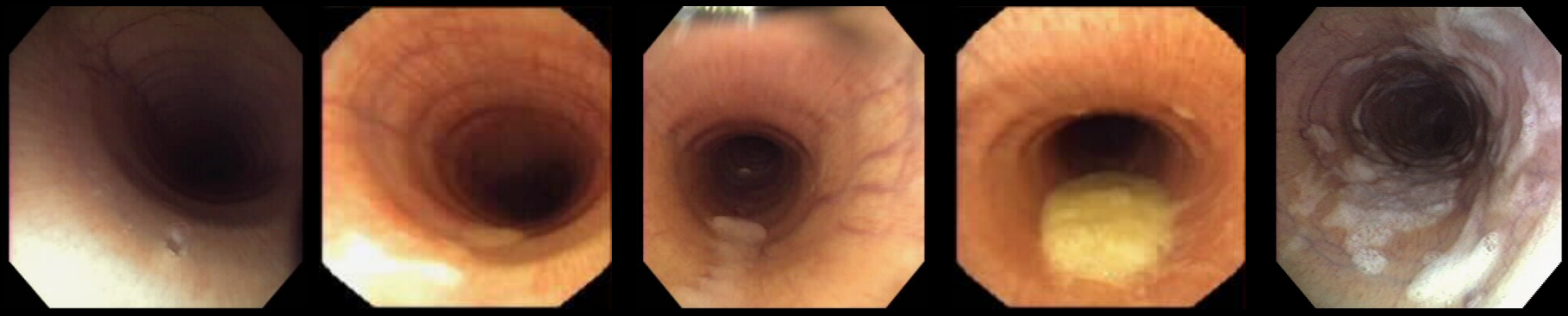


Figure 6—Least square mean distance horses finished behind the winner as a function of severity of EIPH among Thoroughbred racehorses (n = 744) in Melbourne, Australia, examined between March 1 and June 18, 2003, for EIPH after racing. Error bars represent SE. *Significantly ($P < 0.05$) different from value for horses with grade 0 EIPH.

Hinchcliff et al. 2005

Clinical evaluation of the RT

- Respiratory system
  - Lower airway endoscopy post-exercise
    - Grade ≥ 2 associated with poor performance in THB race horses (Holcombe et al. 2006)
    - Grade ≥ 3 associated with poor performance in sport horses (Widmer et al. 2008)

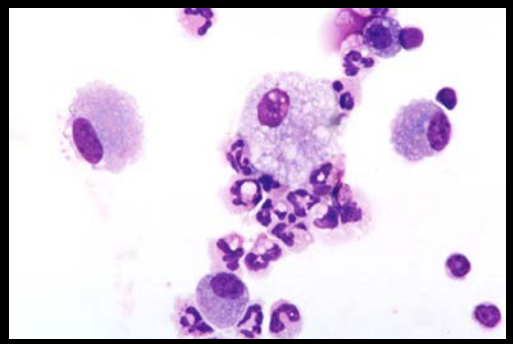


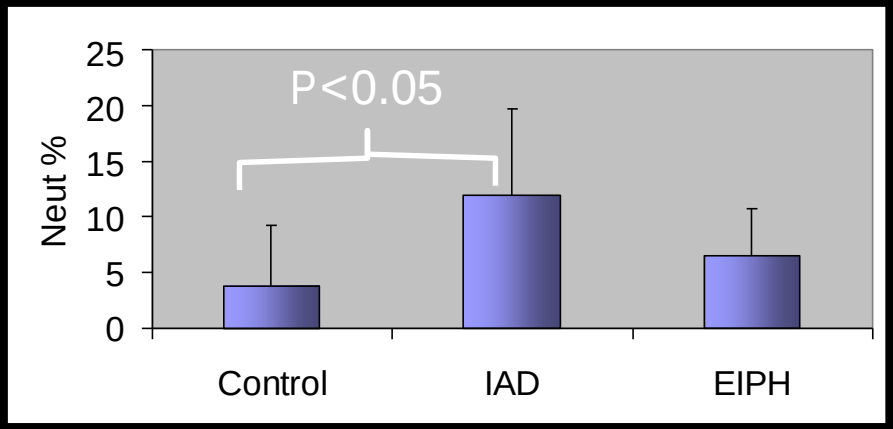
1 2 3 4 5

Gerber 2004

Clinical evaluation of the RT

- Respiratory system
  - BALF neutrophilia (> 5 %)
    - IAD associated with poor performance
    - STBD (Rush 1995; Couroucé 2002)
    - THB (Fogarty 1991)
  - TW cytology
    - No association (Holcombe 2006)

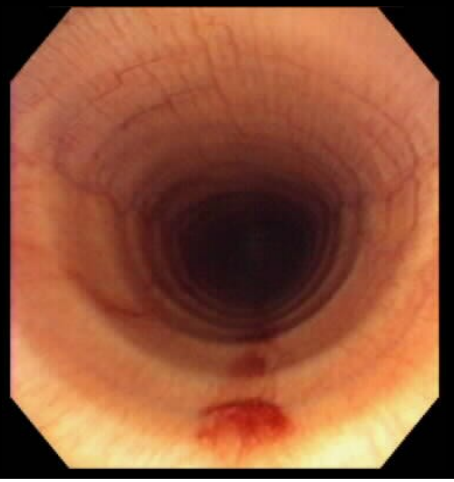


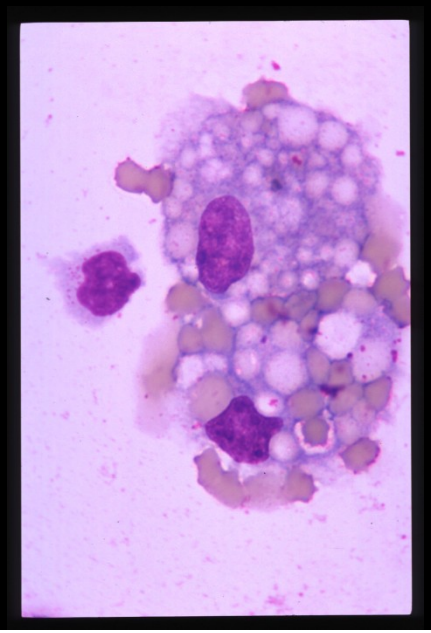


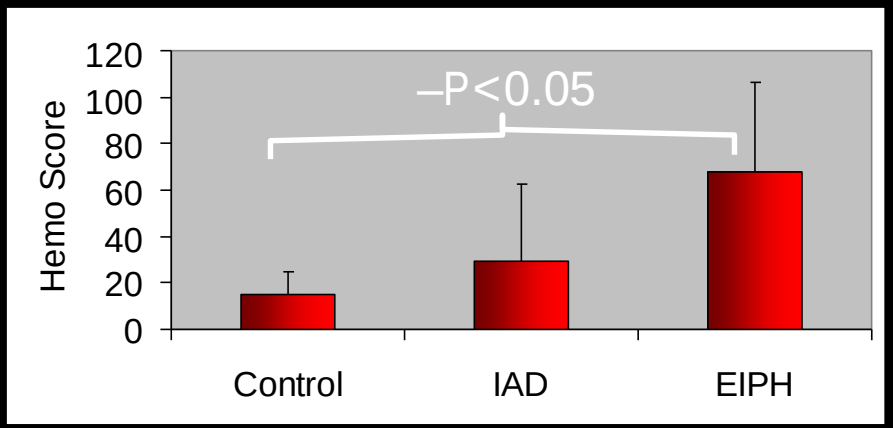
Couetil et al. 1999

Clinical evaluation of the RT

- Respiratory system
  - BALF
    - EIPH
    - % hemosiderophages
    - [RBC]



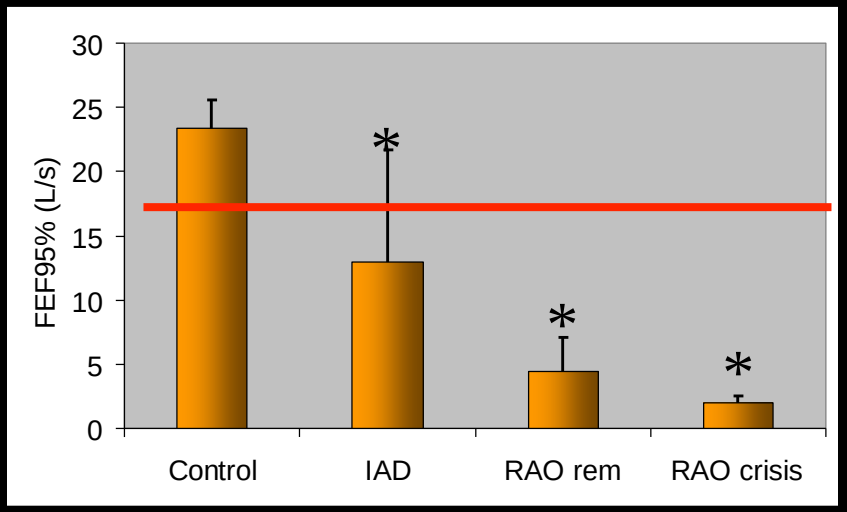


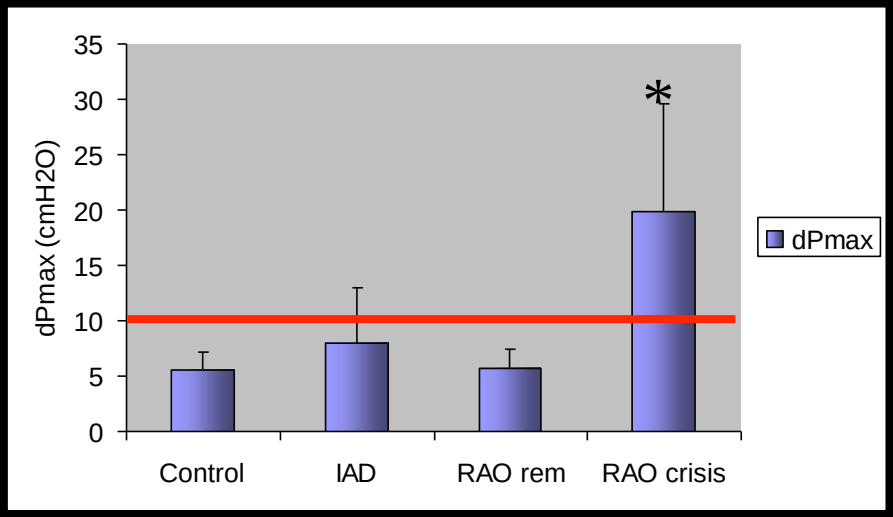


Couetil et al. 1999

Advanced lung function tests

- Standard lung mechanics
- FE (forced expiration)
- FOM / IOS





Advanced lung function tests

- Open Plethysmography
  - Commercially available
    - RAO crisis
    - IAD (AHR)

–Courtesy Ambulatory Monitoring, Inc.

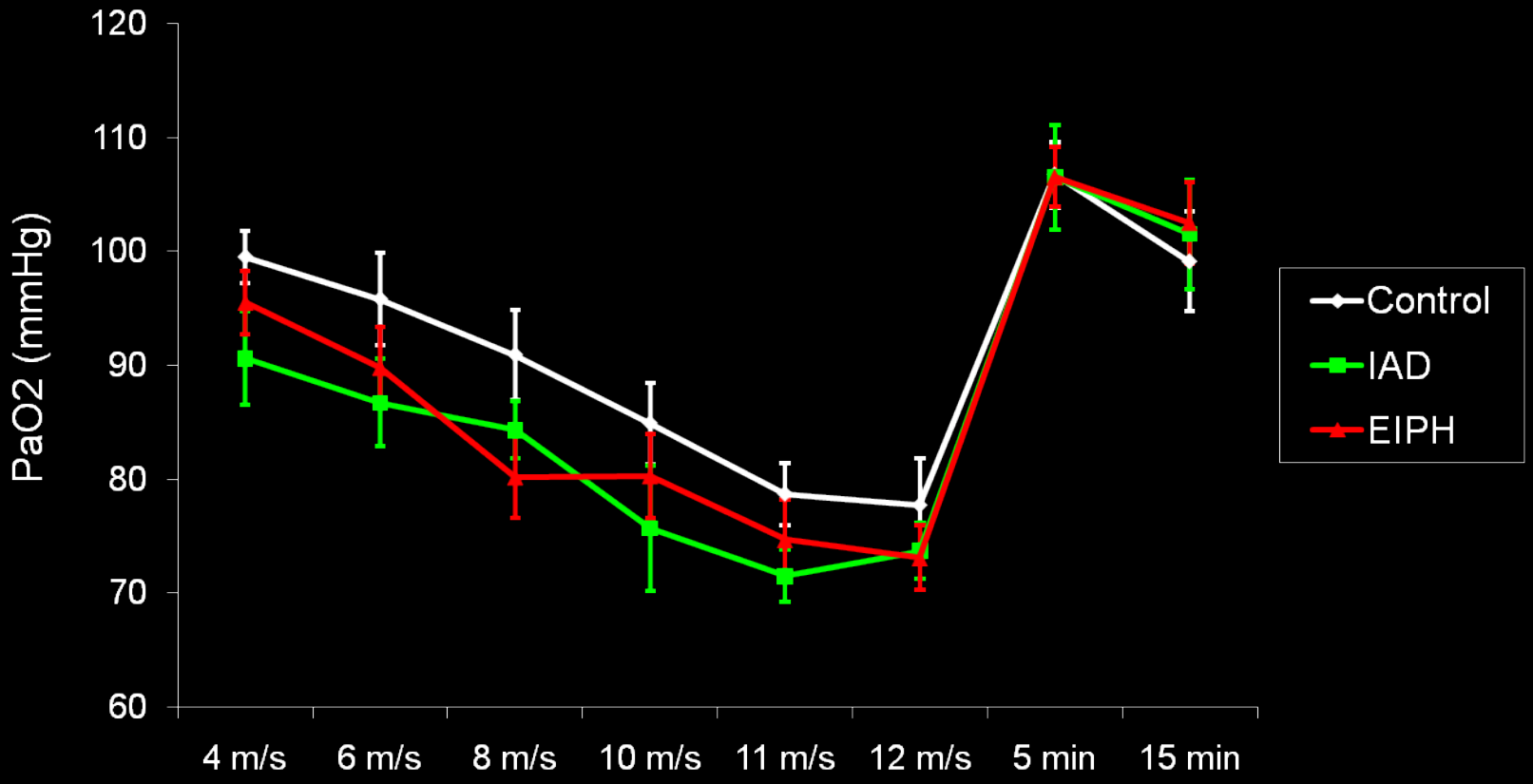
Exercise testing

- Treadmill / Field
  - Indications
    - Poor performance at moderate-high intensity exercise
    - Significance of abnormality found
  - Advantages:
    - Controlled environment
    - Standardized protocol
    - Numerous data collected
  - Weaknesses:
    - Gait differences
    - No rider
    - Costly

Exercise testing

- Evaluation focused on:
  - Upper airway (endoscopy)
    - Treadmill
    - Dynamic endoscopy in the field
  - Gas exchanges, ventilation

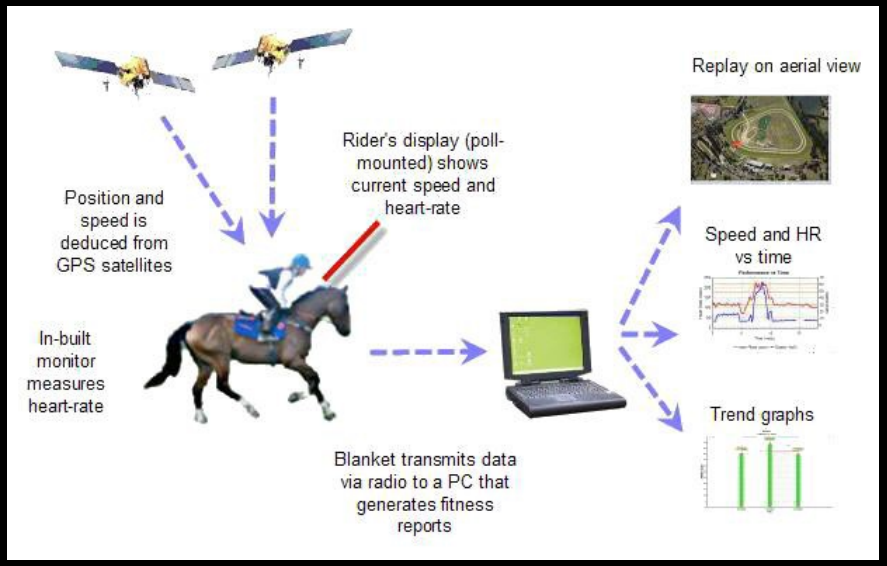
Exercise testing



Couëtil et al., Equine Vet J 1999

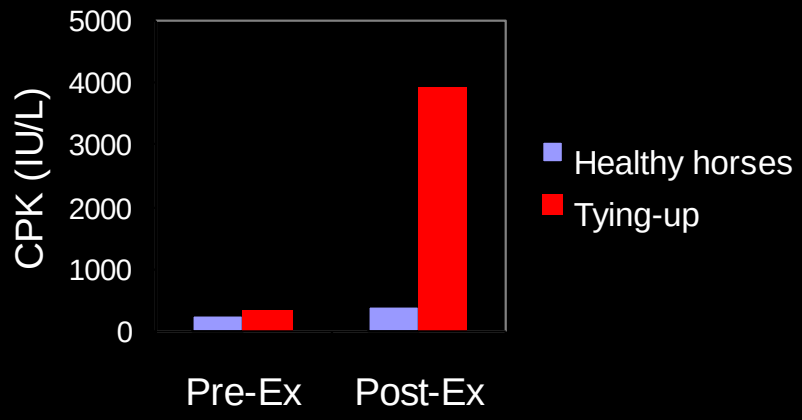
Exercise testing

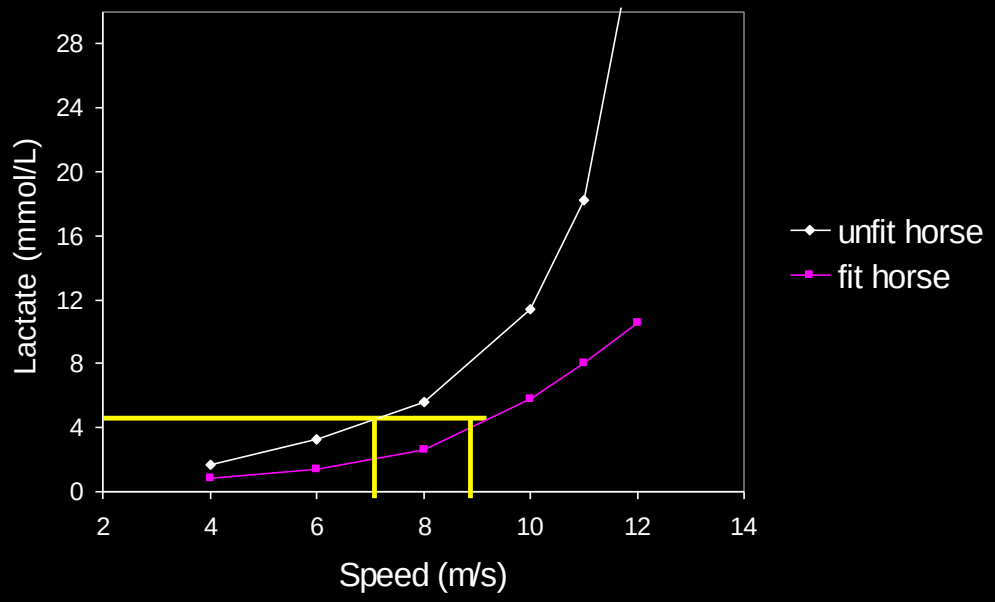
- Cardiovascular function
  - Exercise testing
    - Field / Treadmill
    - V_{150} & V_{200}



Exercise testing

- Musculo-skeletal system
  - Fitness (V_{La4})
  - Tying-up





Summary

Exercise type	Respiratory disease	Diagnostic test	Other tests
High intensity, short duration	UAO IAD EIPH Infections	Endoscopy (dynamic) BAL ± TW Exercise testing Sensitive LFT	Gait at high speed Lactate HR / ECG CK pre-post CBC
Moderate intensity, long duration	UAO IAD / RAO Infections	Endoscopy (rest ± dynamic) BAL ± TW Exercise testing Sensitive LFT	Lameness exam Lactate HR / ECG CBC / electrolytes
Low intensity, long duration	UAO IAD / RAO IPF Infections	Endoscopy (rest) BAL ± TW BG @ rest LFT	Thoracic X-ray / US CBC

Challenging cases

- Unproven horse
  - Reference database
  - Systematic evaluation
    - Treadmill
    - Field
  - Cause of poor performance
    - Legitimate cause
    - Undiagnosed pathology
    - Limited ability / lack of fitness
    - Behavior / psychological problem

Questions?