

# 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 ( $> 80\% \text{VO}_{2\text{max}}$ )
  - Moderate (50-80%  $\text{VO}_{2\text{max}}$ )
  - Low ( $< 50\% \text{VO}_{2\text{max}}$ )
- Fitness level



# Approach to poor performance evaluation

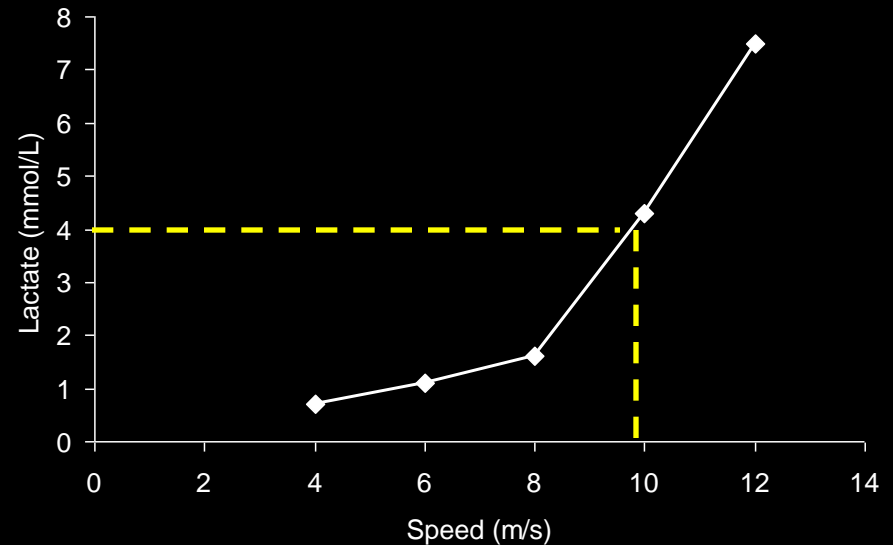
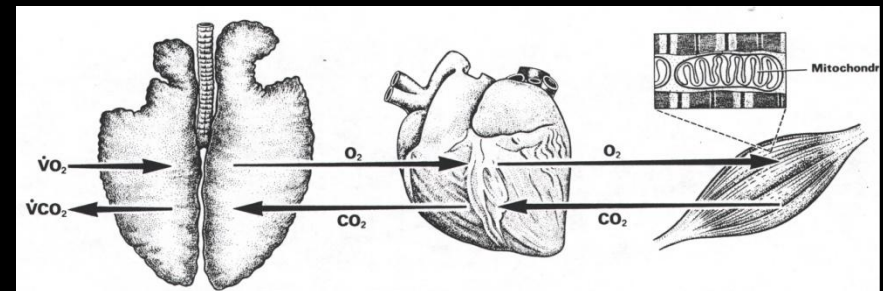
<b>Exercise Intensity</b>	<b>Performance</b>	<b>Disease severity</b>	<b>Test sensitivity</b>
High	↓ performance	+	+++
Moderate	↓ performance / exercise intolerance	++	++
Low	exercise intolerance	+++	+

# Approach to poor performance evaluation

- Compare measurements to reference database
  - Objective performance criteria (running time, finishing position)
  - Physiological parameters
    - Guide therapy
  - Clinical signs
    - Response to therapy
- Compare parameters measured longitudinally
  - Objective performance criteria
  - Physiological parameters
  - Clinical signs (coughing, noise, lameness, etc.)

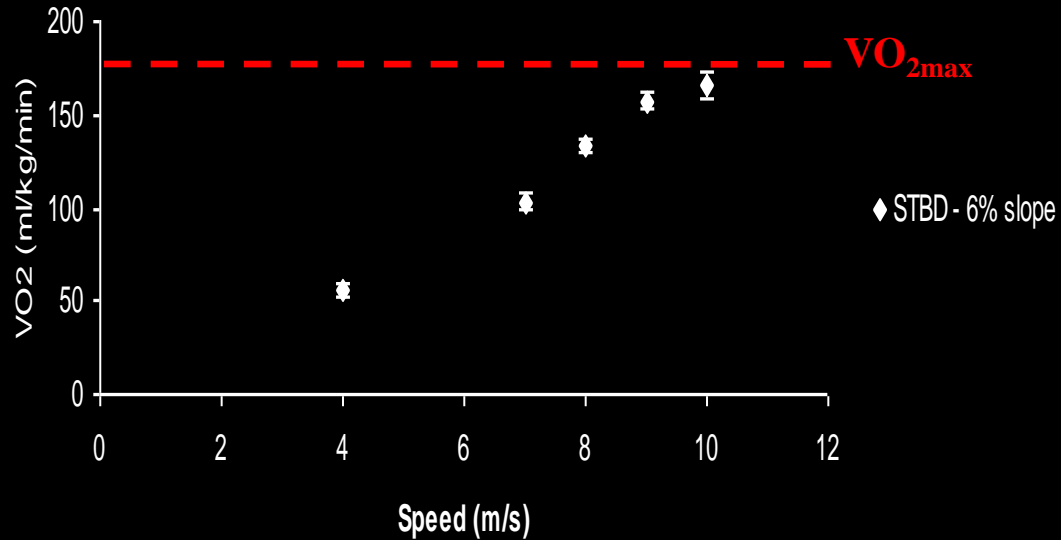
# Adaptation to exercise

- Respiratory
  - $V_E \times 30$
- CardioV.
  - HR  $\times 8-10$
  - CO  $\times 10$
  - [Hb]  $\times 2$
- Muscular
  - $> 80\%$  CO during strenuous exercise
  - Lactate



# Adaptation to exercise

- $\text{VO}_{2\text{max}} = 40 \times \text{VO}_{2\text{rest}}$
- $\text{VO}_2 \parallel \text{HR}$



# Adaptation to training

- Functional adaptations

- Skeletal

- CardioV.

- HRmax

- $\uparrow$  Heart mass & SV

- [Hb]  $\uparrow$  15 %

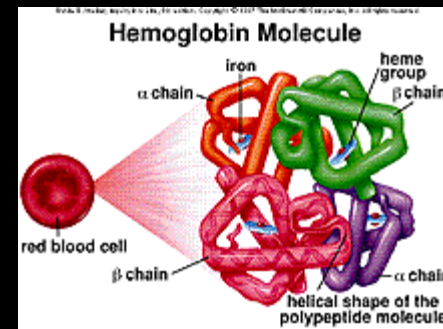
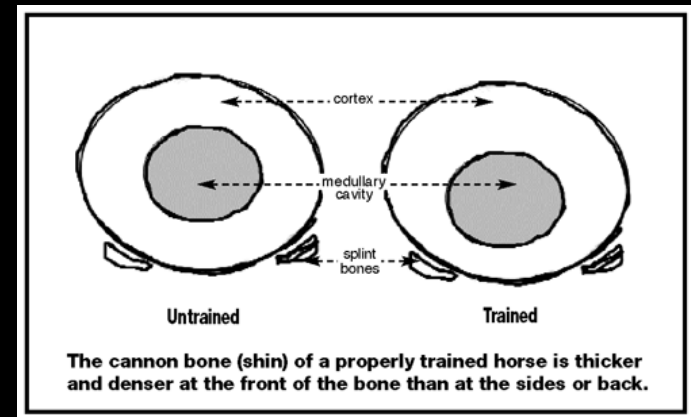
- Muscular

- Fiber hypertrophy

- $\uparrow$  capillary density

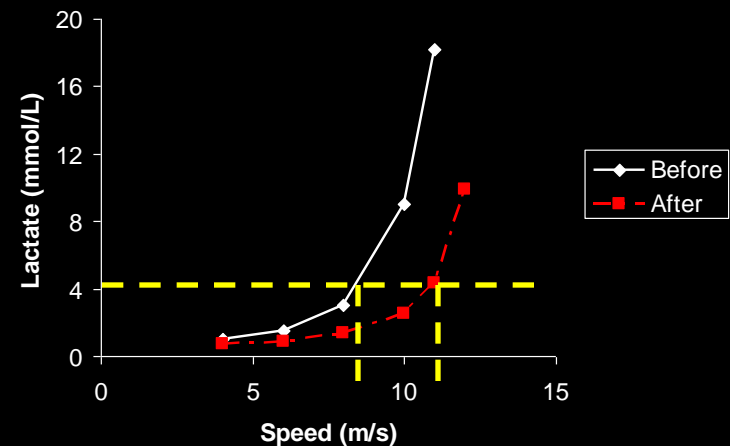
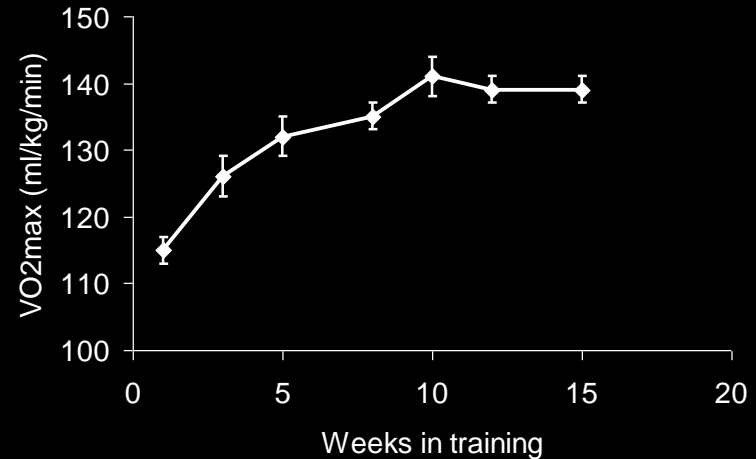
- Respiratory

- No change in VEmax



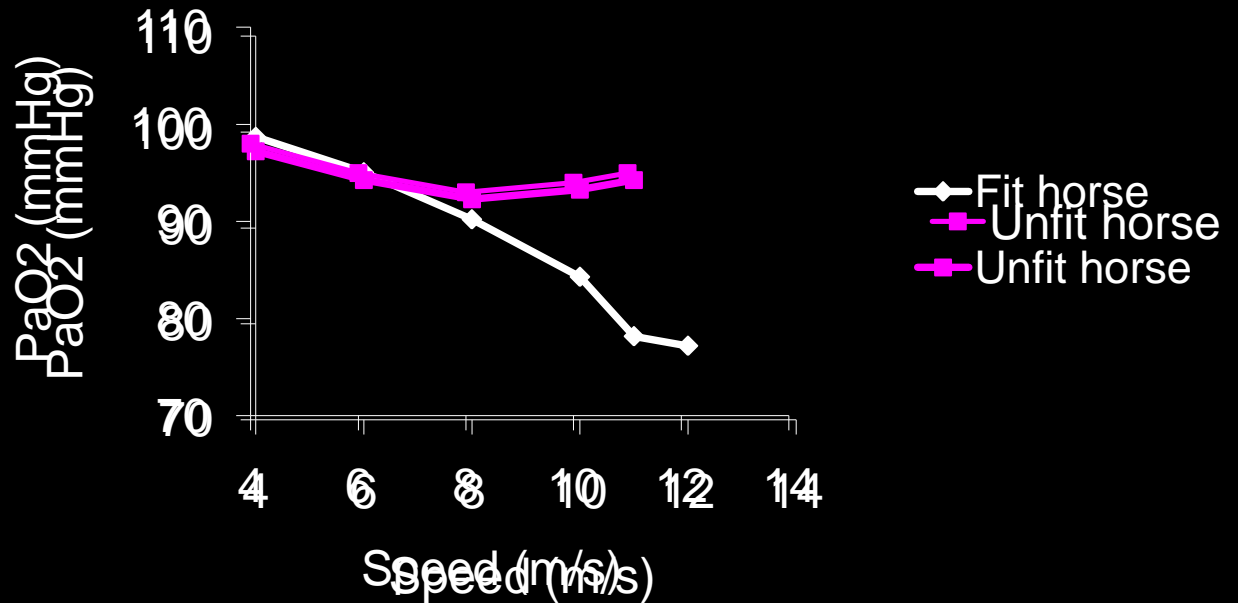
# Adaptation to training

- $\text{VO}_2\text{max}$ 
  - Exercise capacity
  - Athletic potential
  - Training  $\uparrow$  10 – 25 %
- $V_{\text{La4}}$ 
  - $\uparrow$  20 – 30 %
  - Fitness



# Adaptation to training

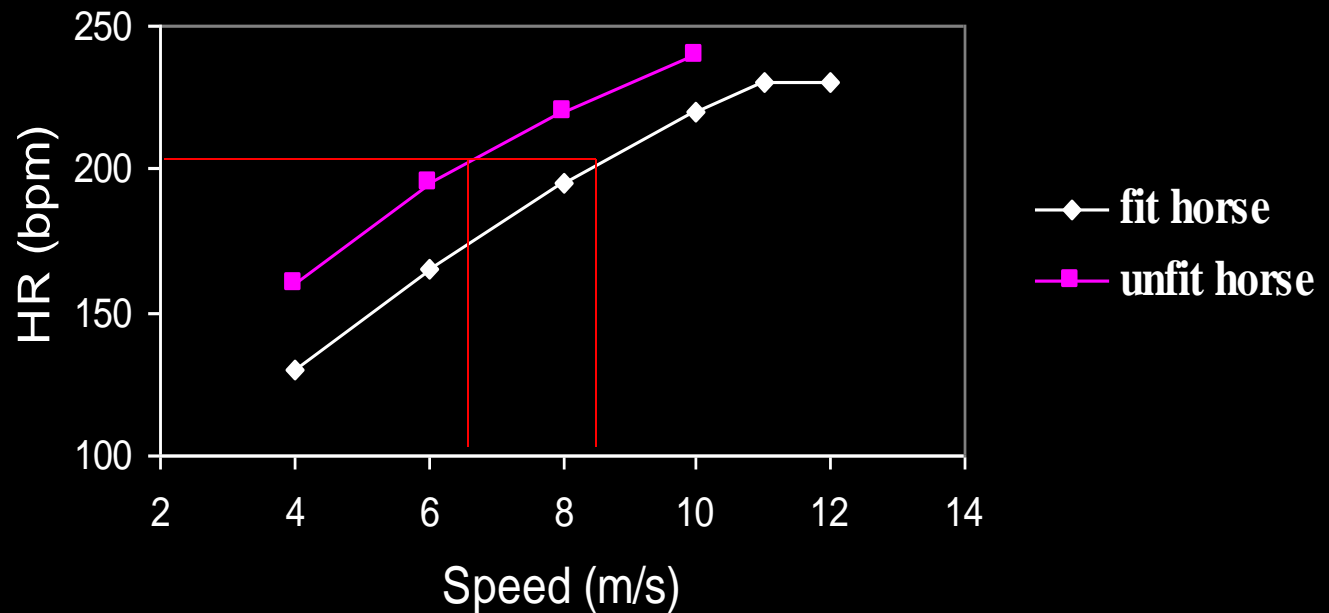
- Gas exchanges
  - Exercise
  - Training



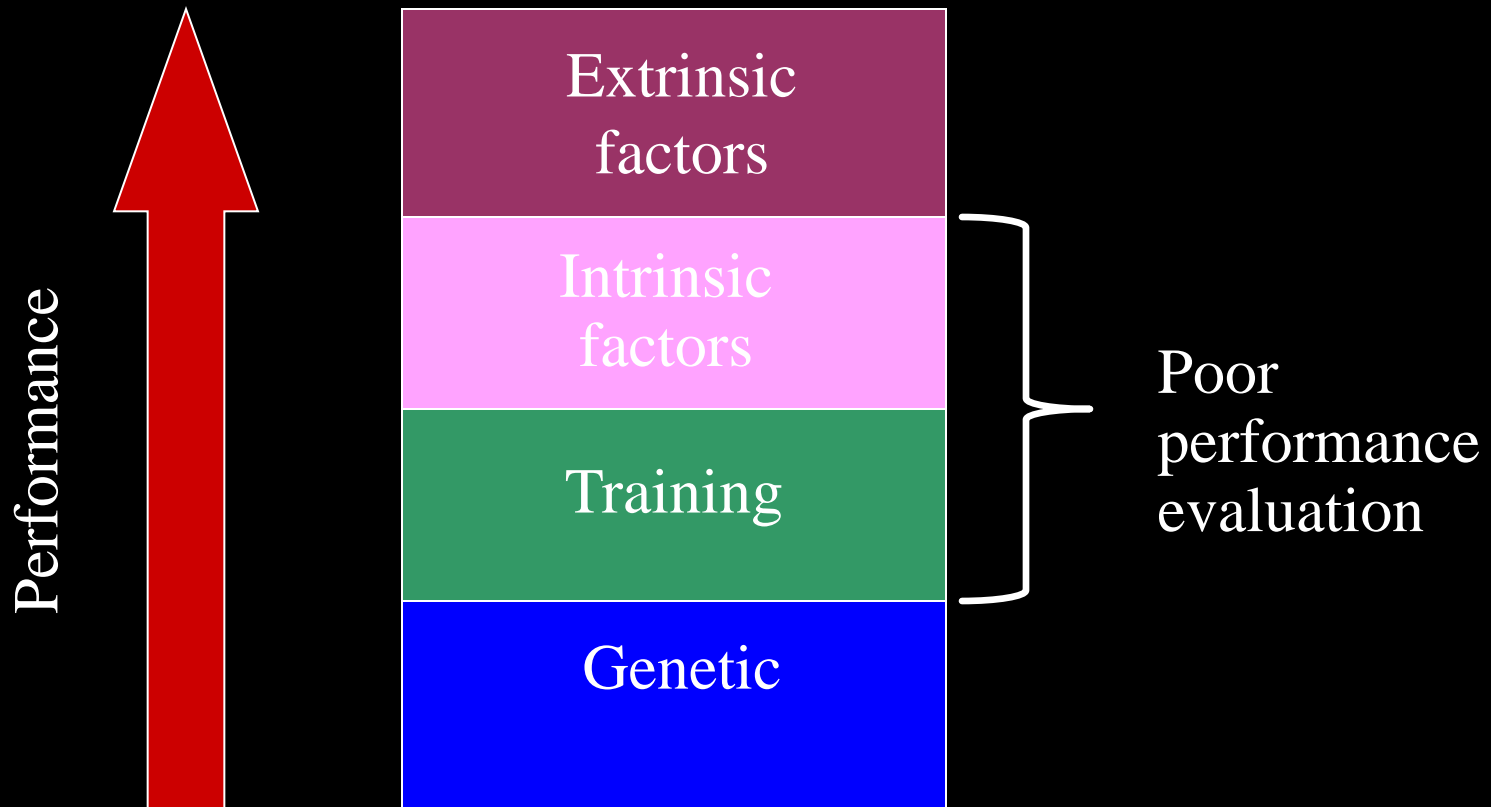
# Adaptation to training

- Heart rate

- Speed vs. HR
- Speed @  $\text{VO}_2\text{max}$  = speed @  $V_{\text{HRmax}}$
- Training
- $V_{200}$



# Factors limiting performance



# Factors limiting performance

Exercise type	Limiting factor	Respiratory disease severity	Body system
High intensity, short duration > 80% VO <sub>2</sub> max	Oxygen delivery  Lactic acid production	+	Respiratory
Moderate intensity, long duration 50-80 % VO <sub>2</sub> max	Combustible, hyperthermia, dehydration	++	Cardiovascular Musculoskeletal
Low intensity, long duration  < 50 % VO <sub>2</sub> max	Fitness	+++	Musculoskeletal

# Clinical evaluation of the RT

- Respiratory system
  - UAW endoscopy at rest



# Clinical evaluation of the RT

- Respiratory system
  - LAW endoscopy post-exercise

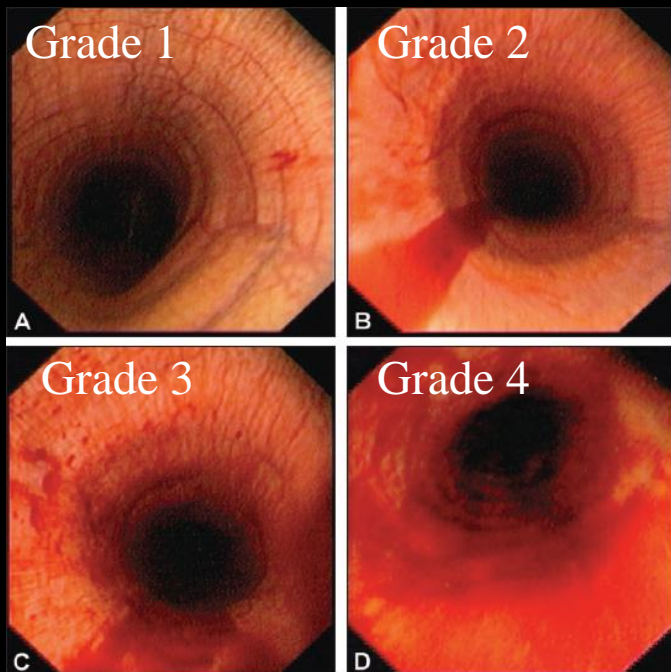


Figure 1—Endoscopic views of grade 1 (A), 2 (B), 3 (C), and 4 (D) exercise-induced pulmonary hemorrhage in Thoroughbred racehorses.

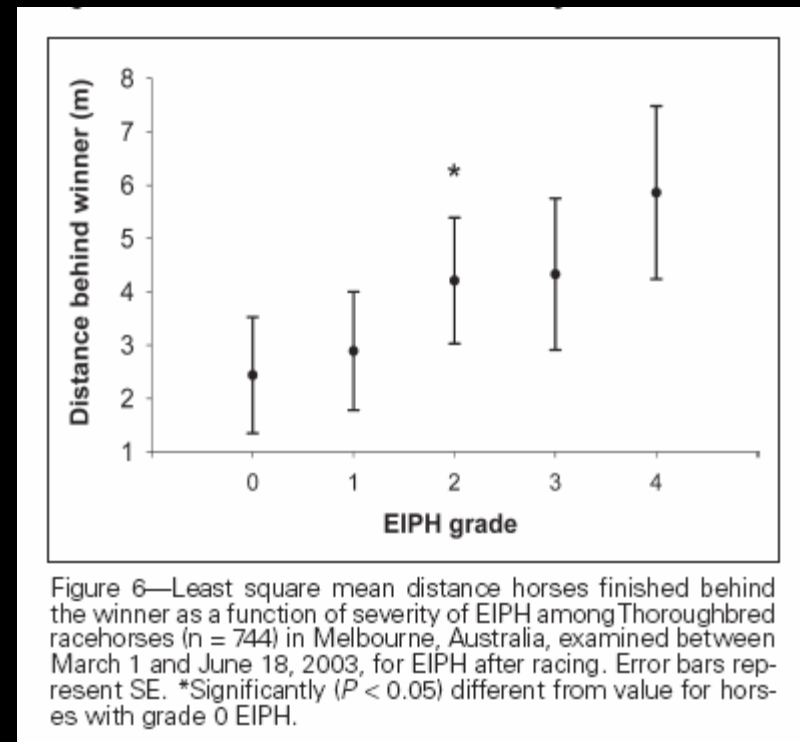
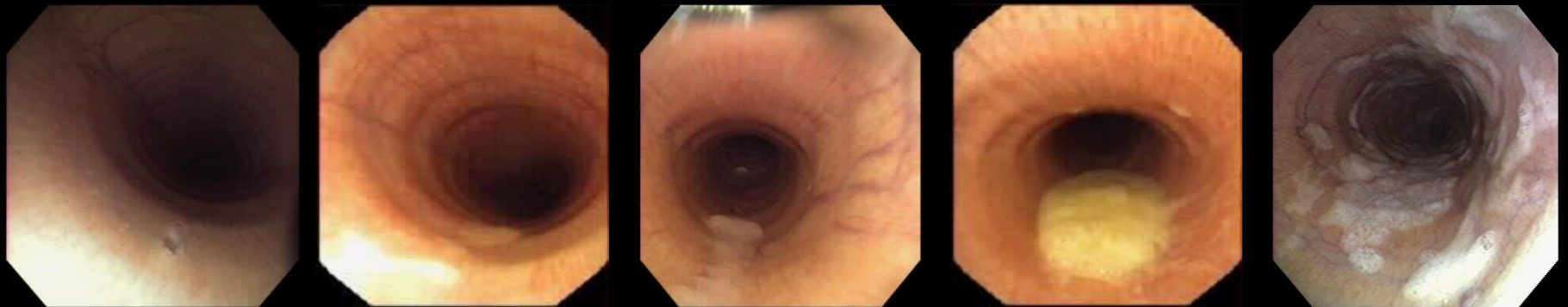


Figure 6—Least square mean distance horses finished behind the winner as a function of severity of EIPH among Thoroughbred racehorses ( $n = 744$ ) in Melbourne, Australia, examined between March 1 and June 18, 2003, for EIPH after racing. Error bars represent SE. \*Significantly ( $P < 0.05$ ) different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

Hinchcliff et al. 2005

# Clinical evaluation of the RT

- Respiratory system
  - LAW endoscopy post-exercise
    - Grade  $\geq 2$  associated with poor performance in THB race horses (Holcombe et al. 2006)
    - Grade  $\geq 3$  associated with poor performance in sport horses (Widmer et al. 2008)



1

2

3

4

5

# Clinical evaluation of the RT

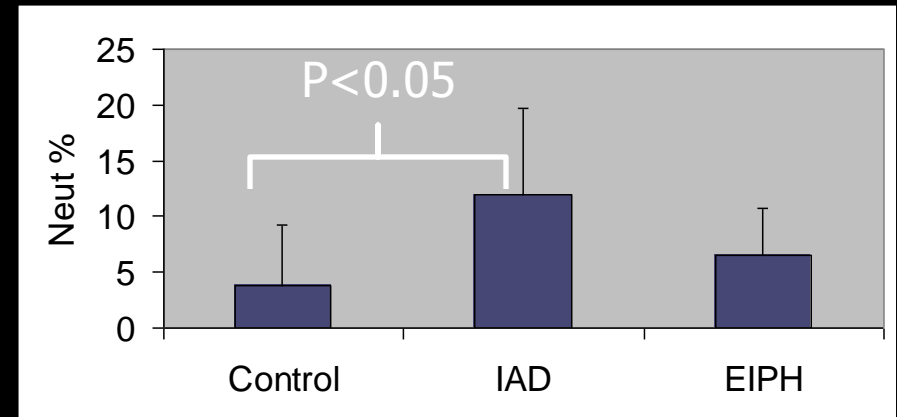
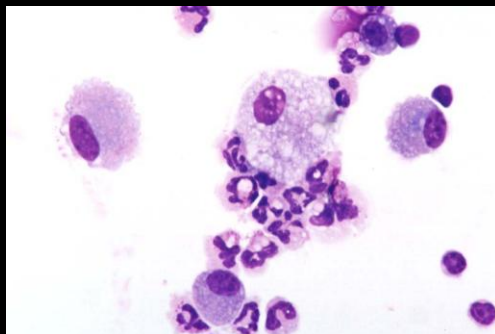
- Respiratory system

- BALF neutrophilia (> 5 %)

- IAD associated with poor performance
    - STBD (Rush 1995; Couroucé 2002)
    - THB (Fogarty 1991)

- TW cytology

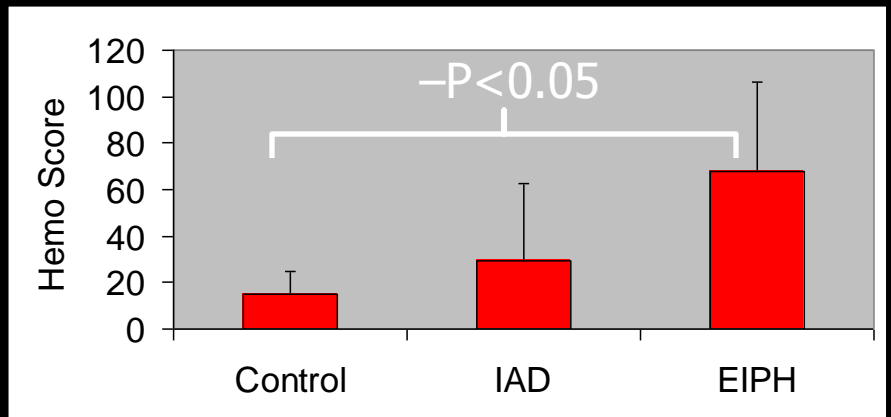
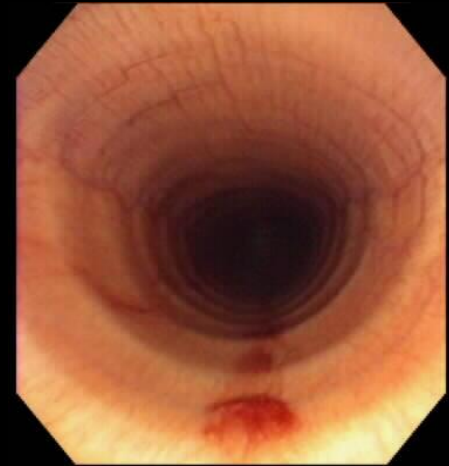
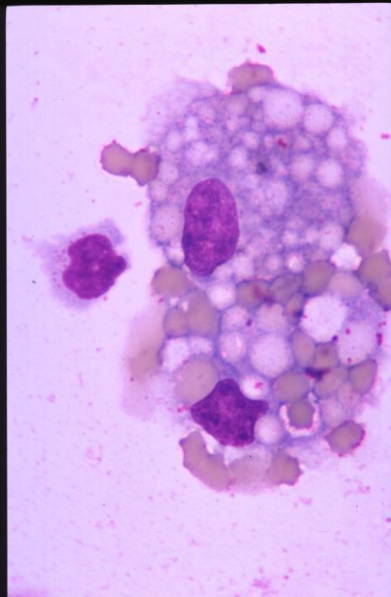
- No association (Holcombe 2006)



Couetil et al. 1999

# Clinical evaluation of the RT

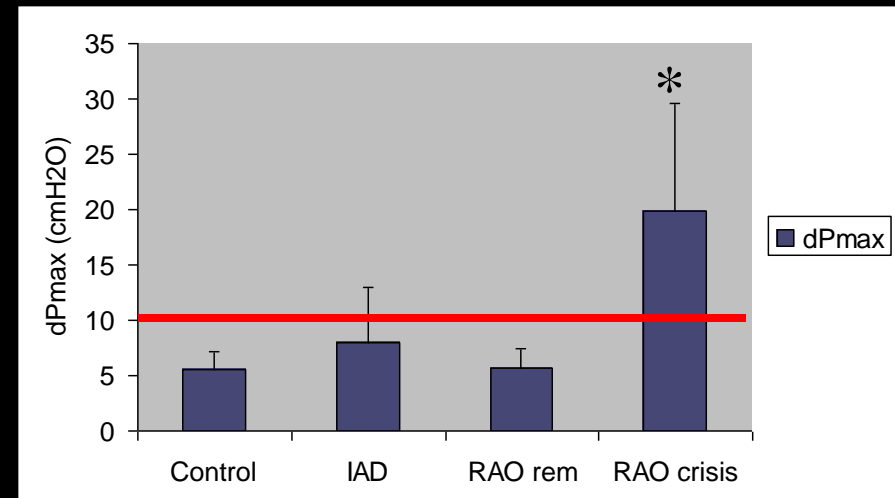
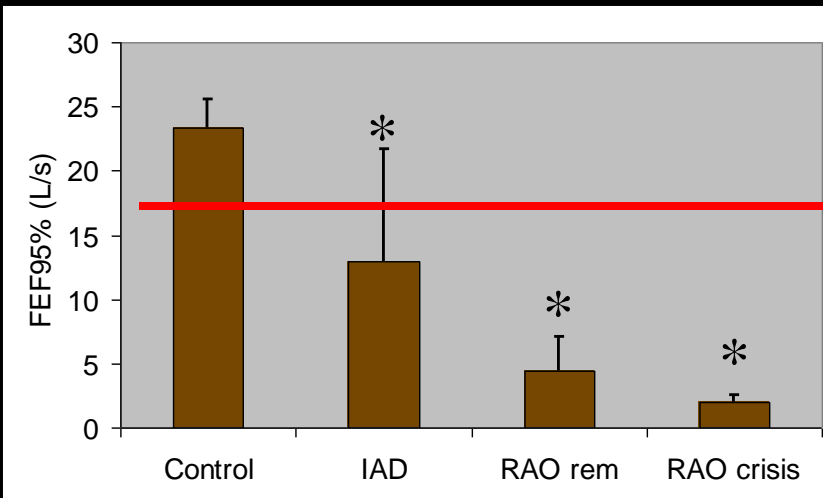
- Respiratory system
  - BALF
    - EIPH
    - % hemosiderophages
    - [RBC]



Couetil et al. 1999

# Advanced lung function tests

- Standard lung mechanics
- FE
- 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

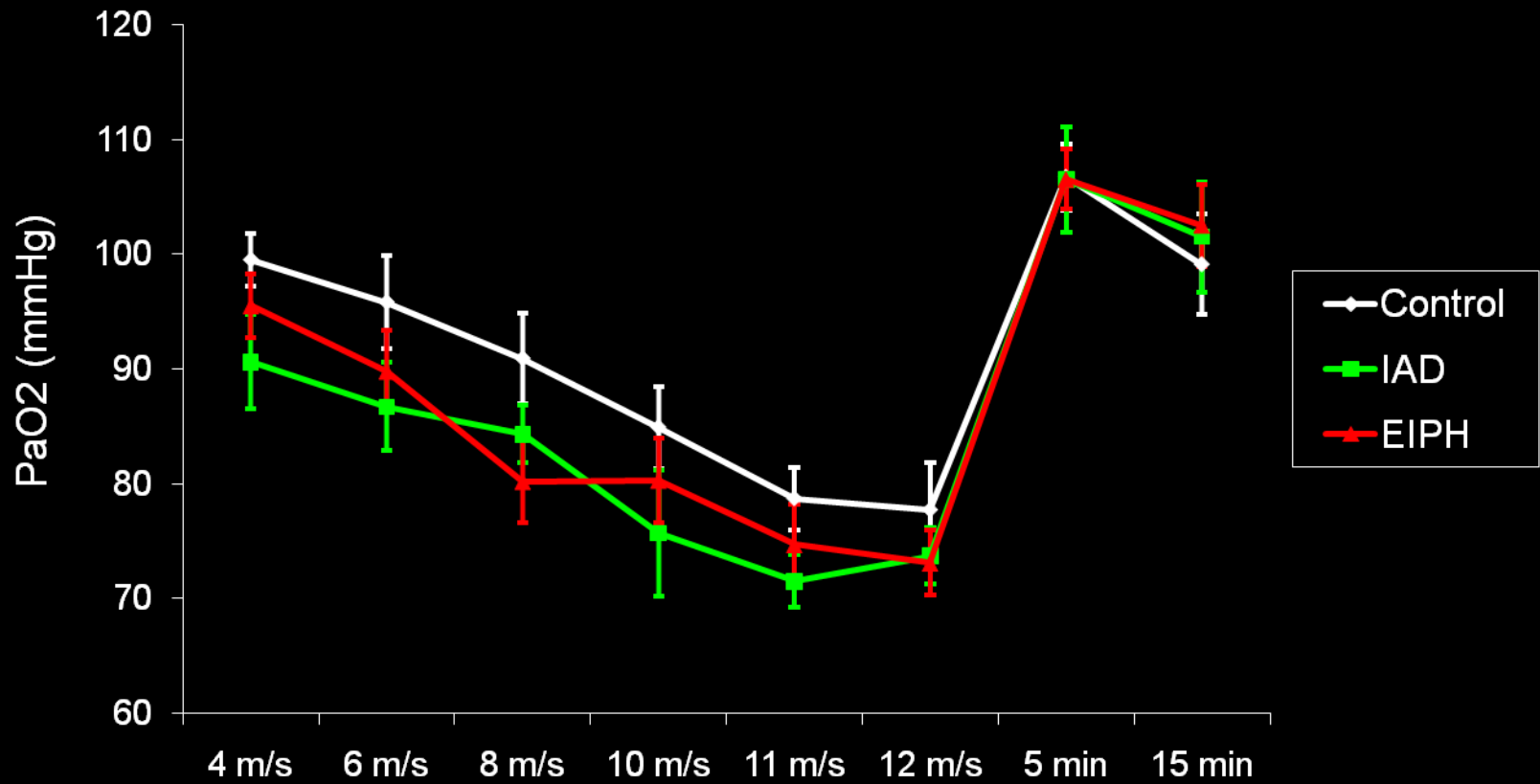


# Exercise testing

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

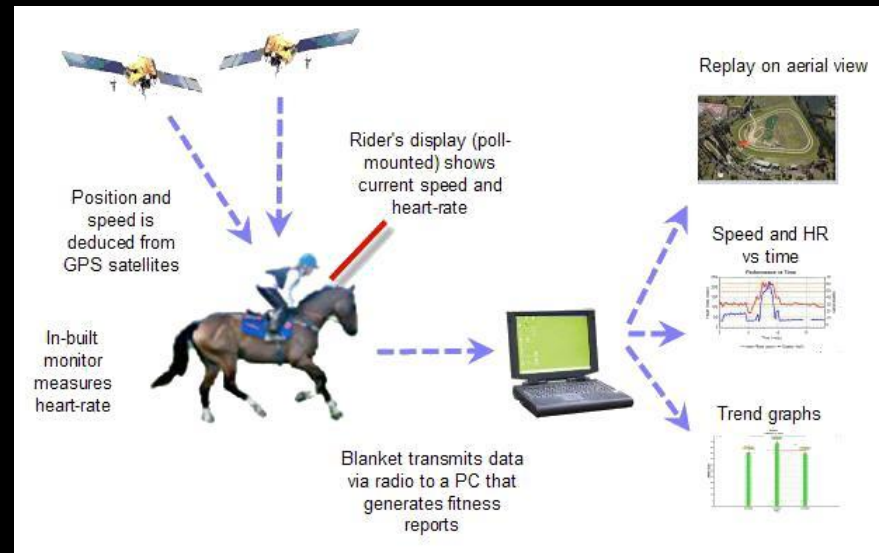


# Exercise testing



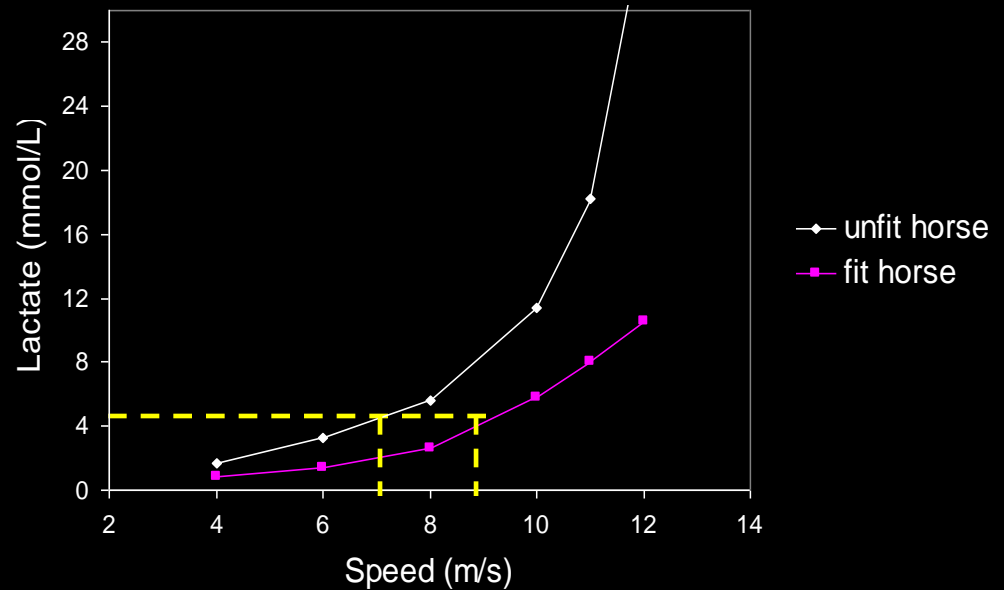
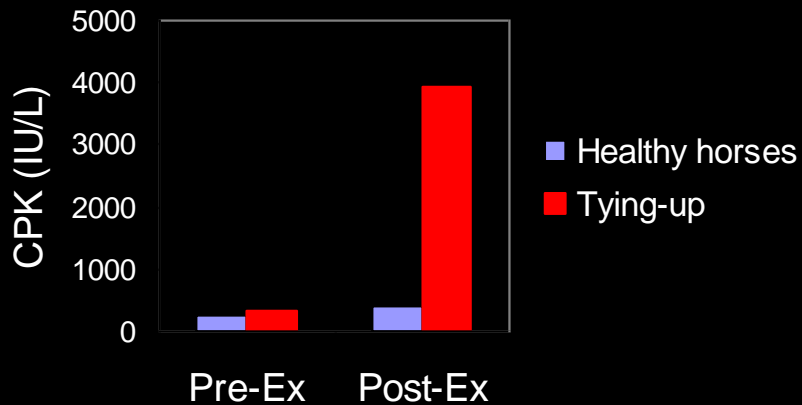
# Exercise testing

- 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?

