Respiratory Health for Performance and the Dangers of EIPH!

Dr David Marlin &
Dr Jim Chiapetta



Breathing – Ventilation - Respiration



Oxygen

Carbon Dioxide

Breathing – Ventilation - Respiration

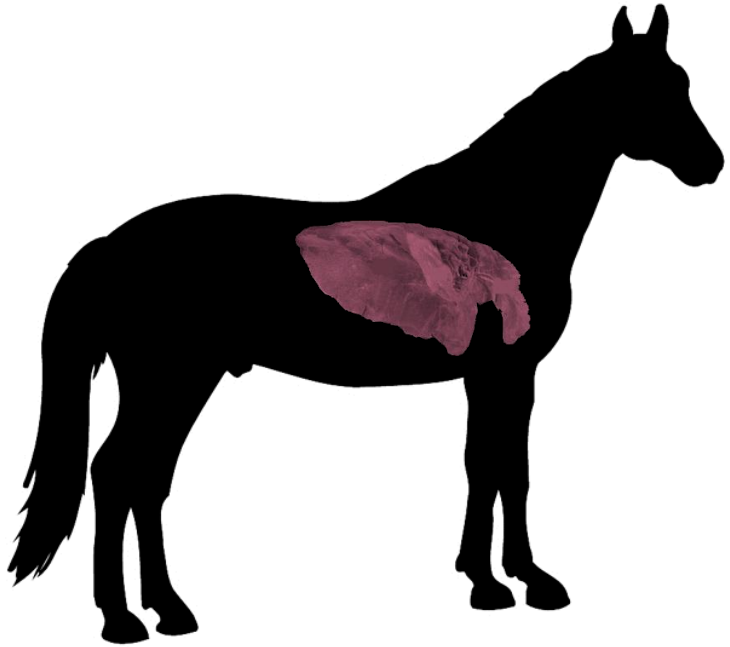


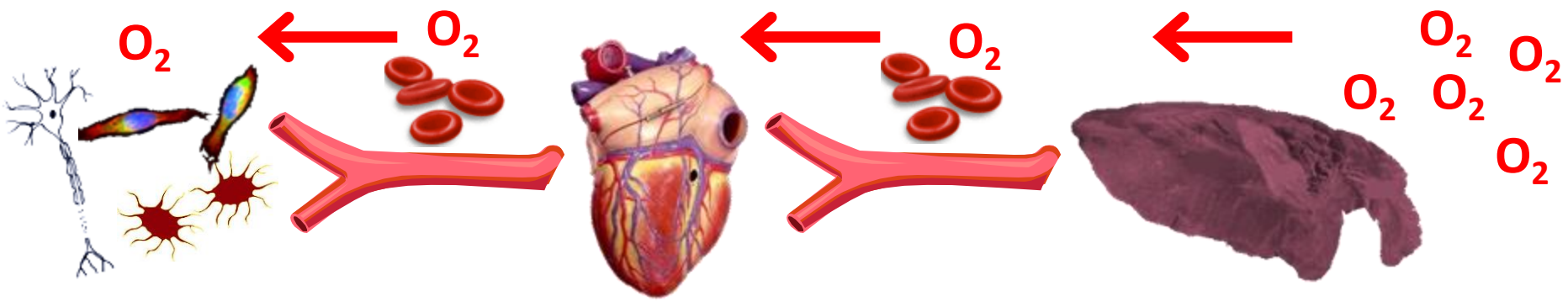
Oxygen

Carbon Dioxide

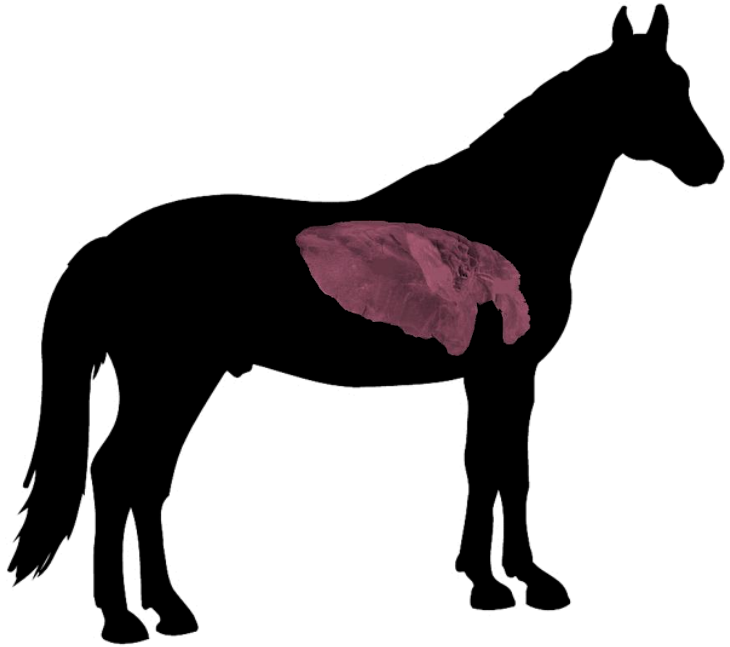
Of the TOTAL ENERGY a horse uses during CANTER or GALLOP, 10-20% is used to move AIR in and out of the LUNGS!

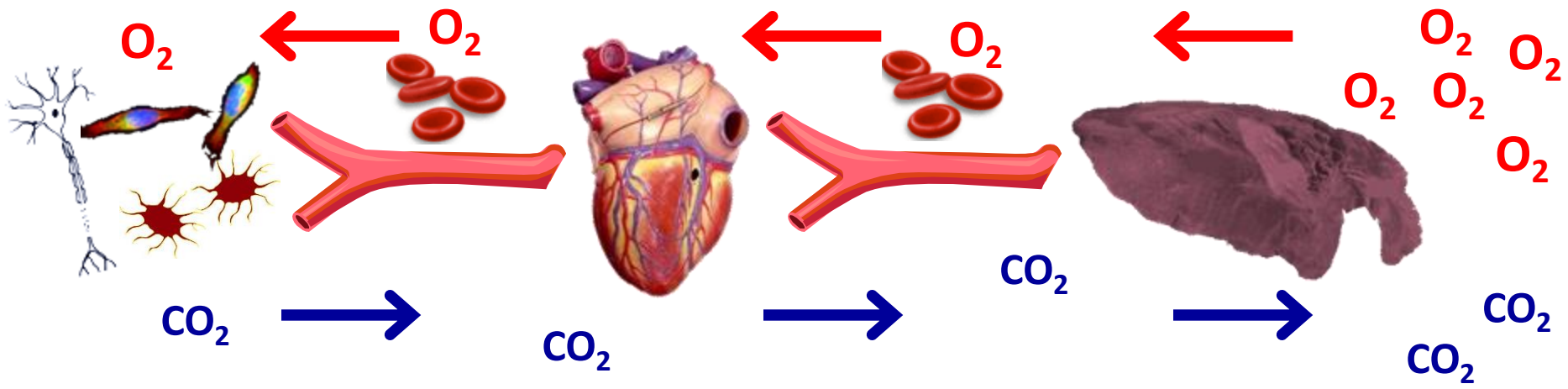
Breathing – Bringing Oxygen into the body!



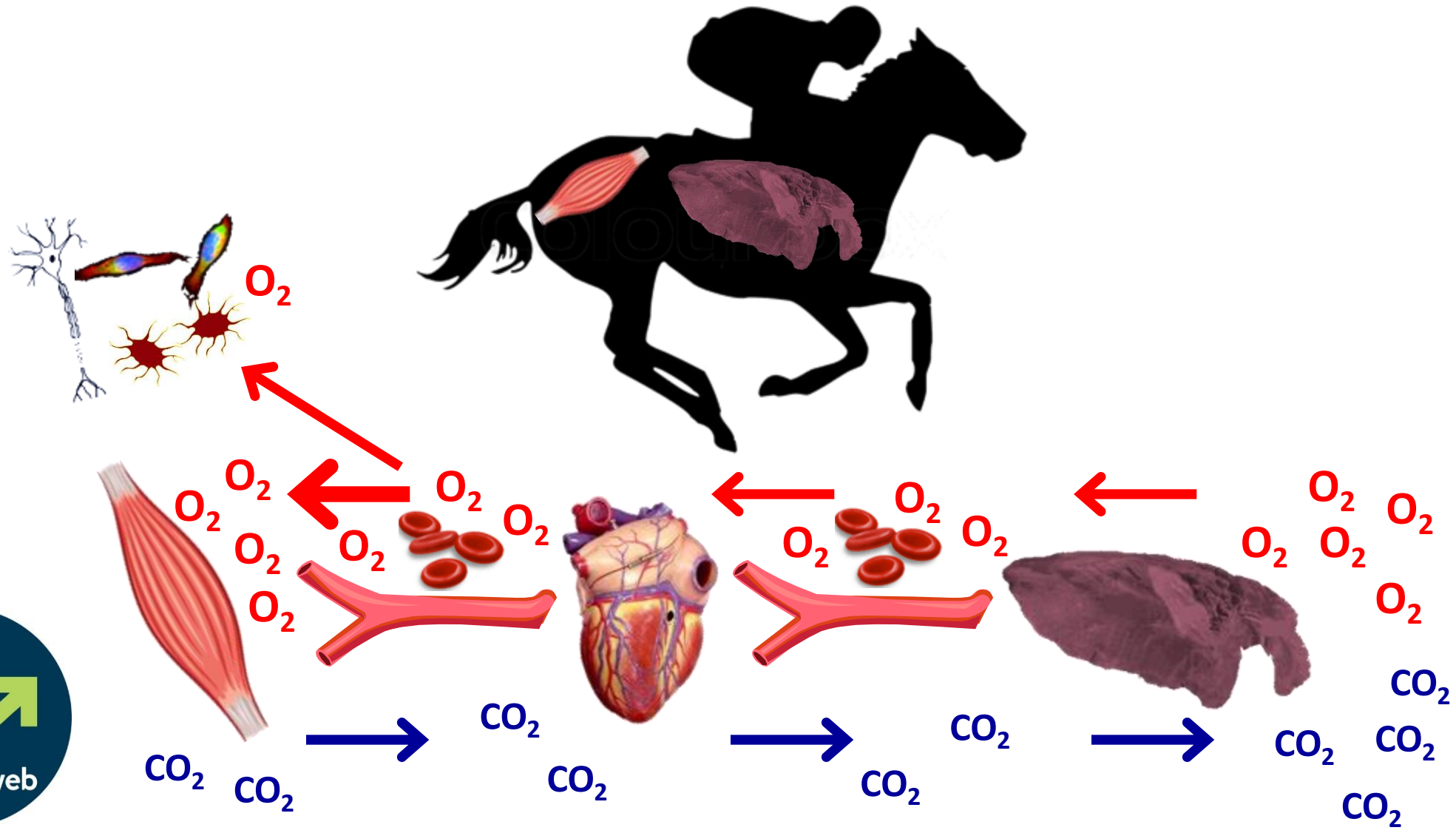


Breathing – Taking Carbon Dioxide out of the body!

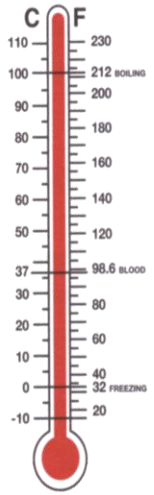




Breathing > Exercise: most Oxygen goes to the MUSCLES

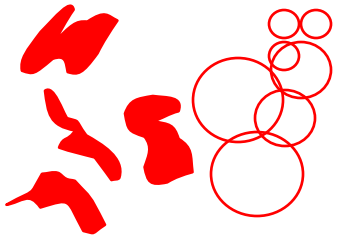


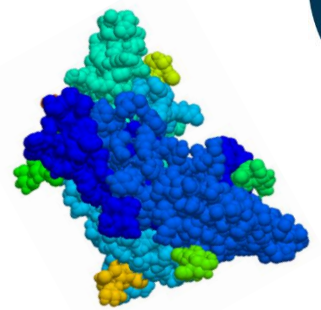
The RESPIRATORY SYSTEM has other important functions!



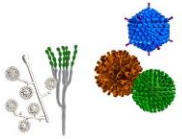
Controlling body temperature

Filtering the blood

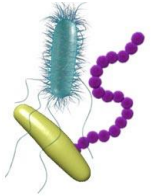




Hormone control

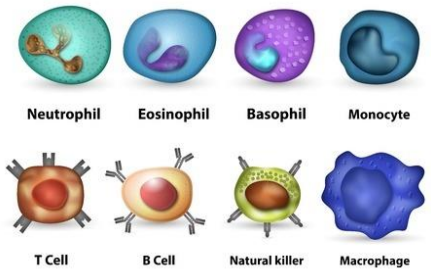


Removing dust, spores, etc

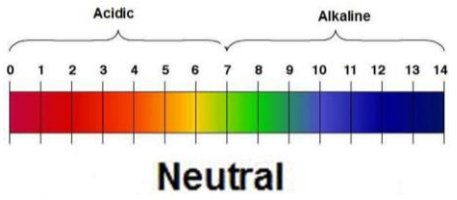


Protecting against infection

Immune system



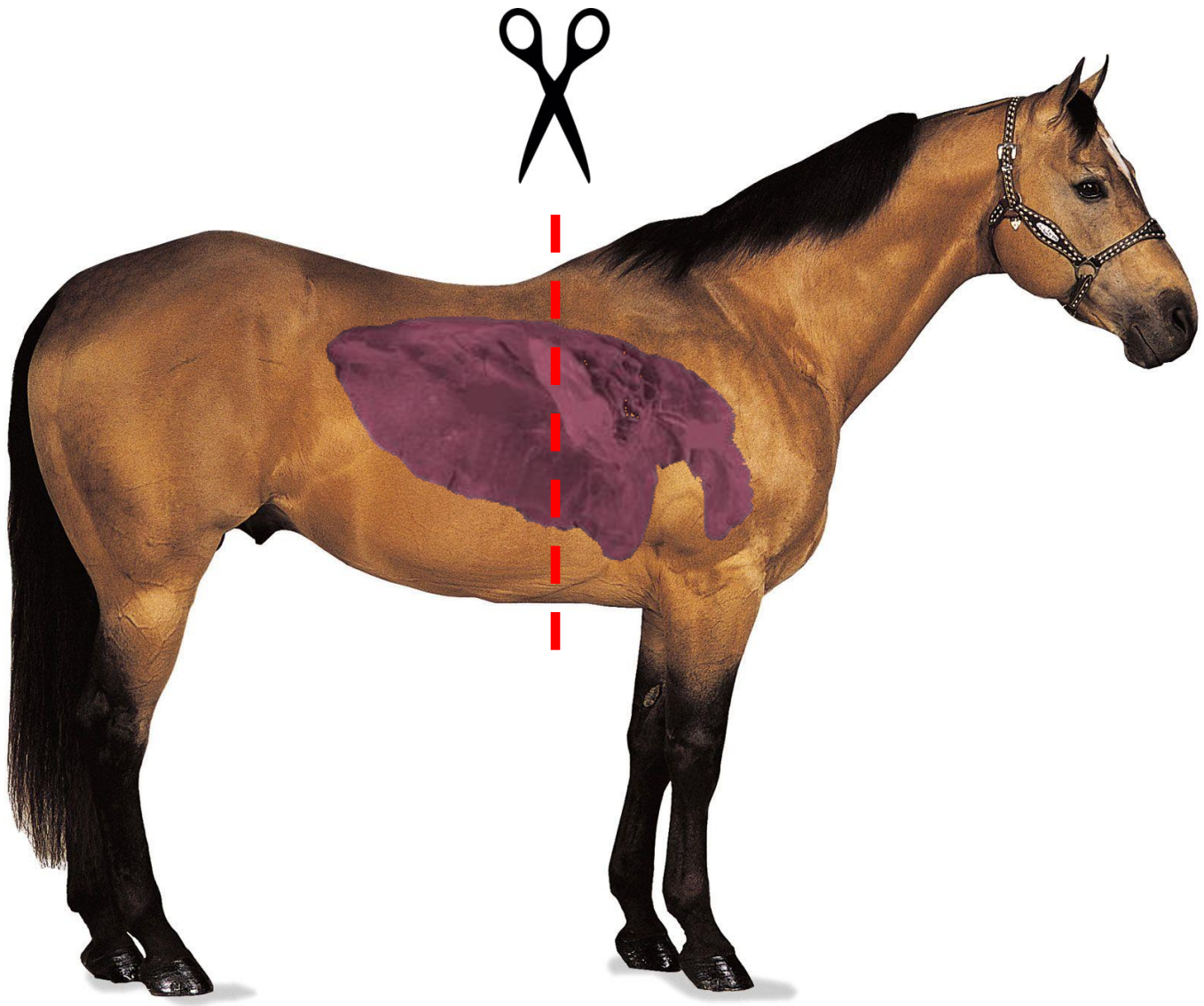
Controlling acidity



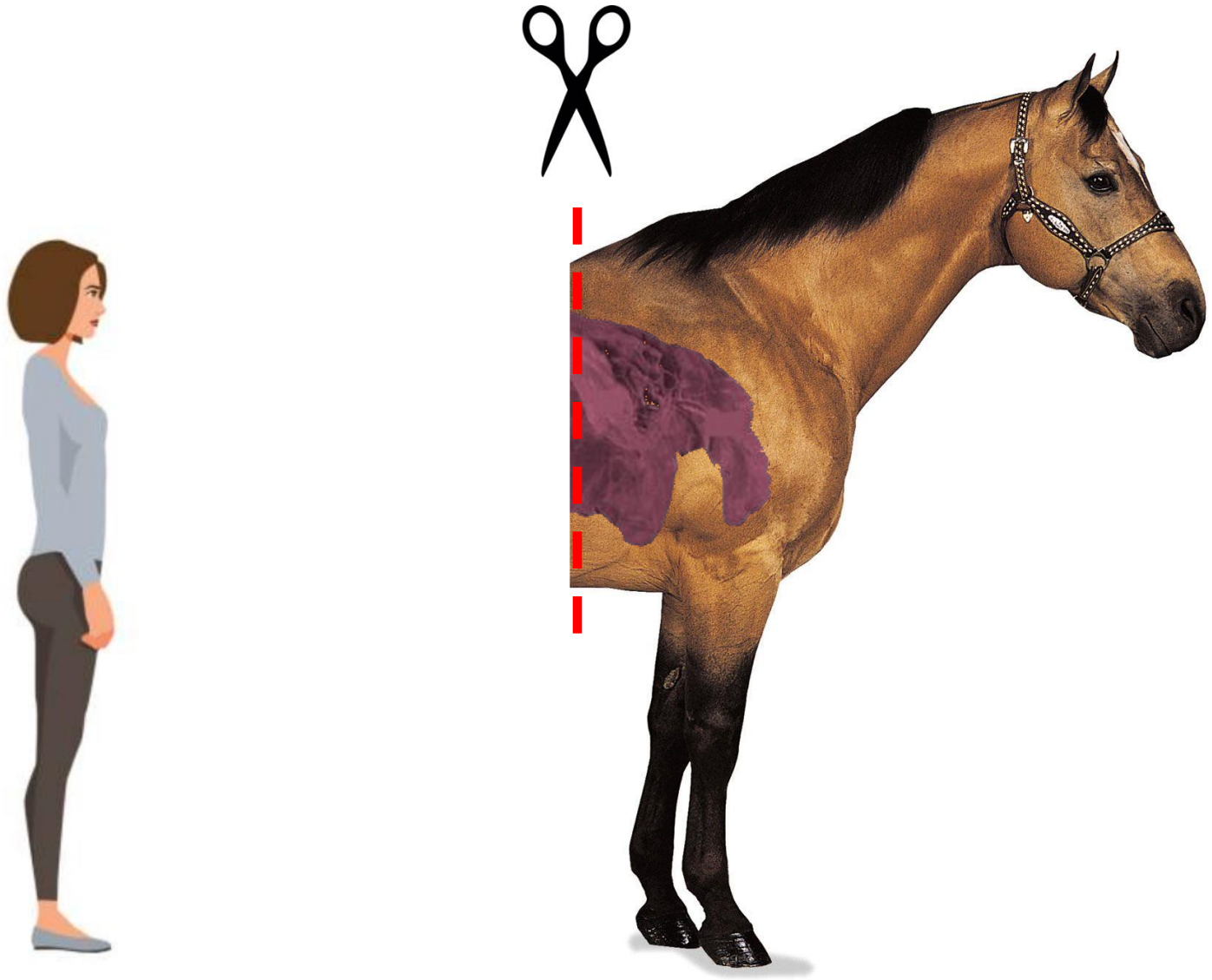
The lungs sit in the rib-cage which is the largest structure of the skeleton



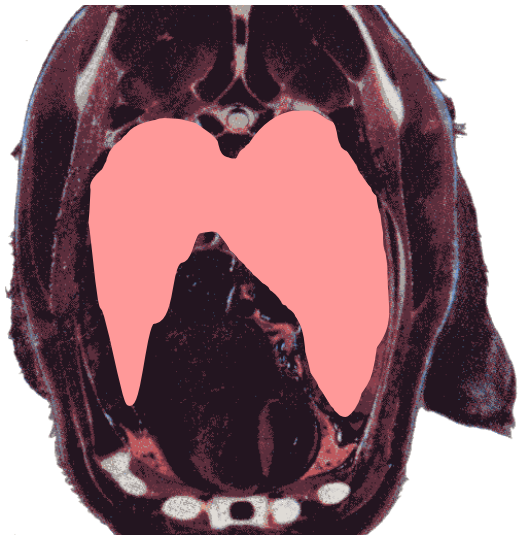
The lungs inside the body



The lungs inside the body

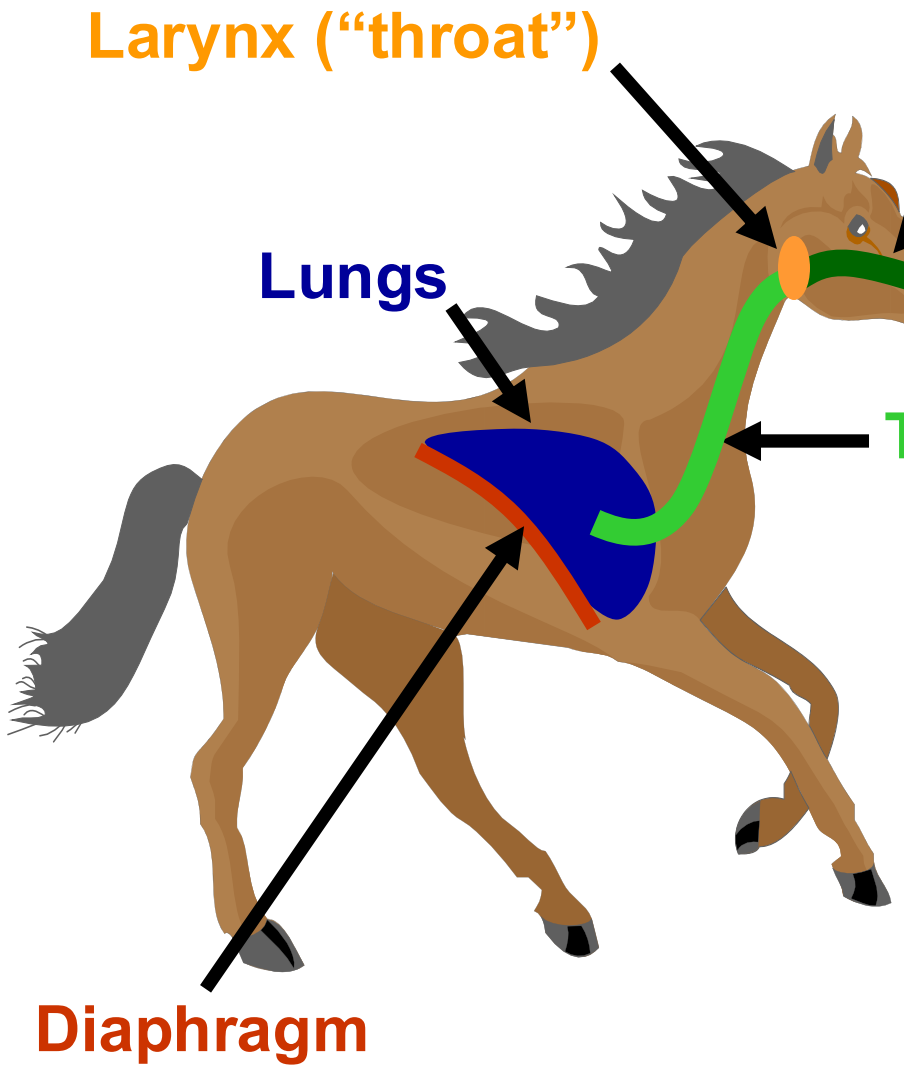


The lungs inside the body





The anatomy of the respiratory system of the horse

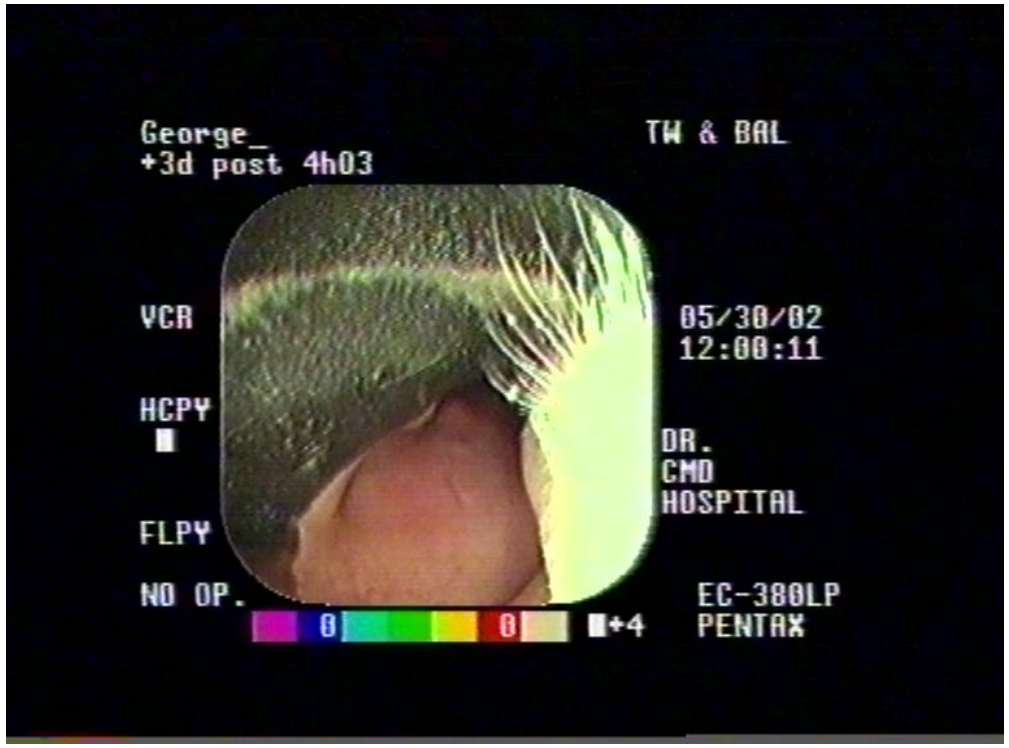


Horses are OBLIGATE NASAL BREATHERS …they can only breathe through their nose!

Animalweb

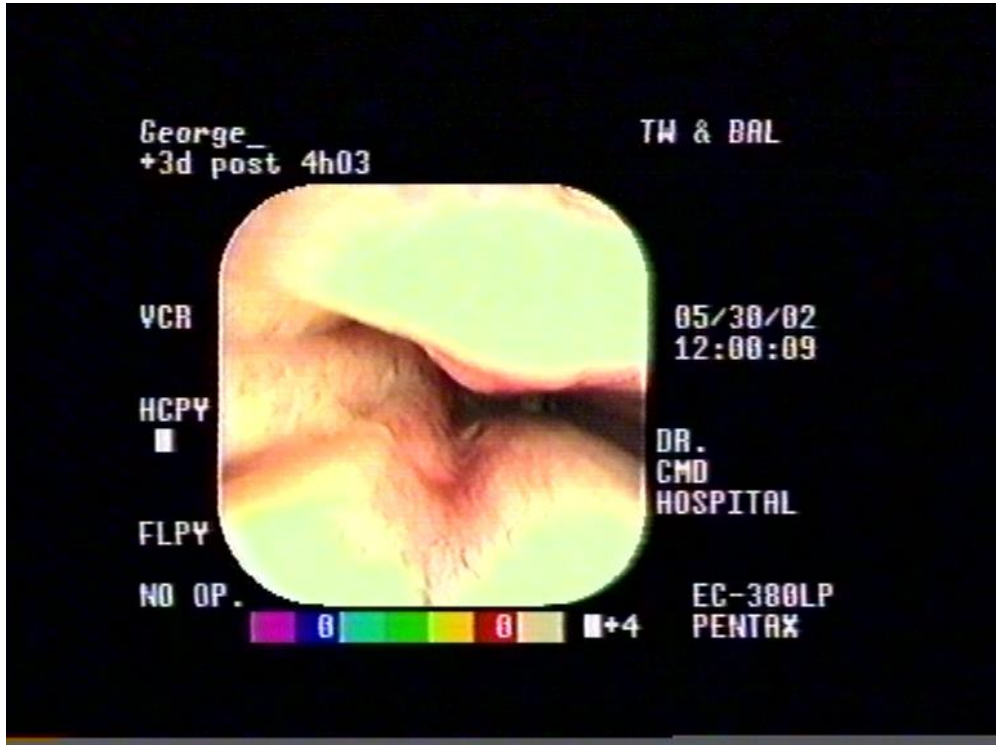
Nostrils




George_
+3d post 4h03
TW & BAL
VCR
05/30/02
12:00:11
HCPY
DR.
CMD
HOSPITAL
FLPY
NO OP.
EC-380LP
PENTAX
0
0
+4

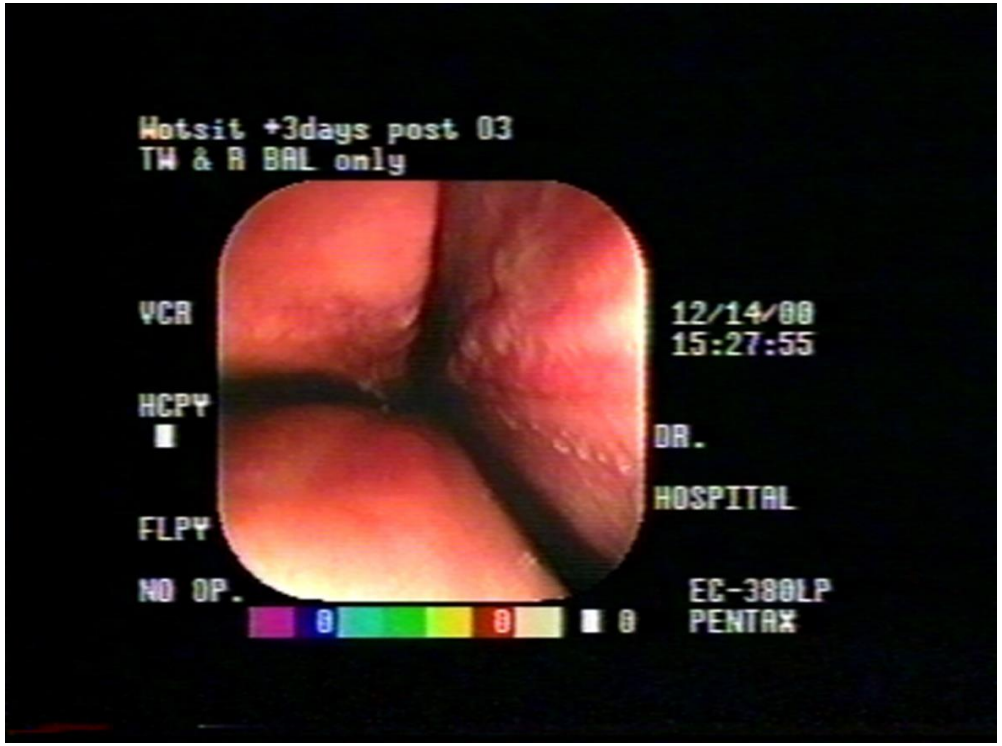
Turbinates




George_
+3d post 4h03
TW & BAL
VCR
HCPY
FLPY
NO OP.
05/30/02
12:00:09
DR.
CMD
HOSPITAL
EC-380LP
PENTAX
0
0
+4

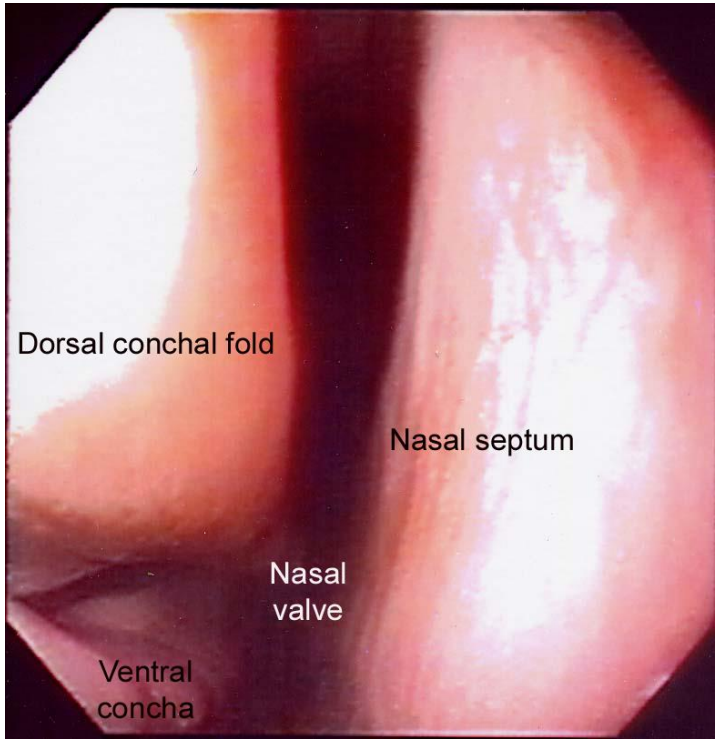
Turbinates




Wotsit +3days post 03
TW & R BAL only
VCR
HCPY
FLPY
NO OP.
12/14/00
15:27:55
DR.
HOSPITAL
EC-380LP
PENTAX

Nasal Valve




Dorsal conchal fold
Nasal septum
Nasal valve
Ventral concha

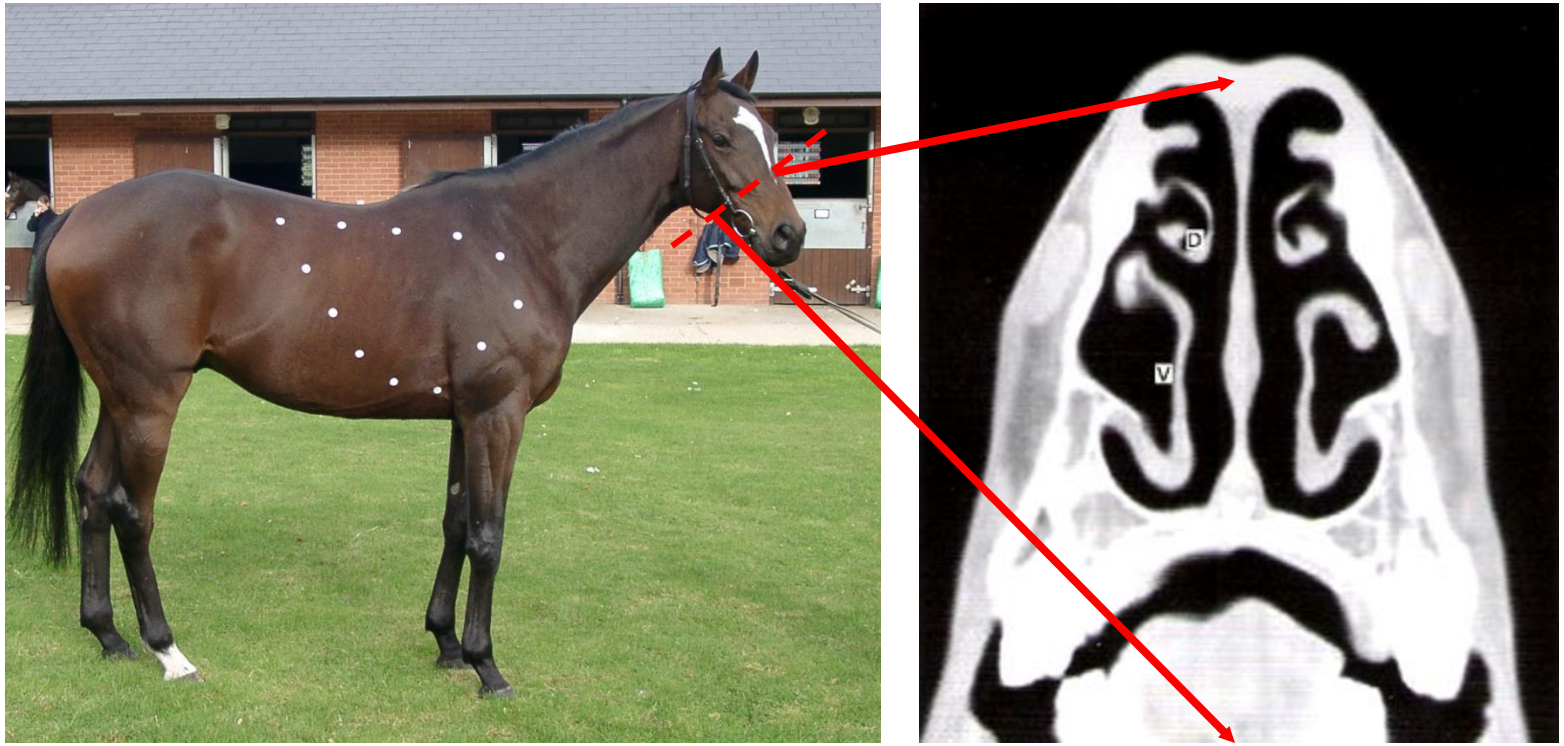
Turbinates





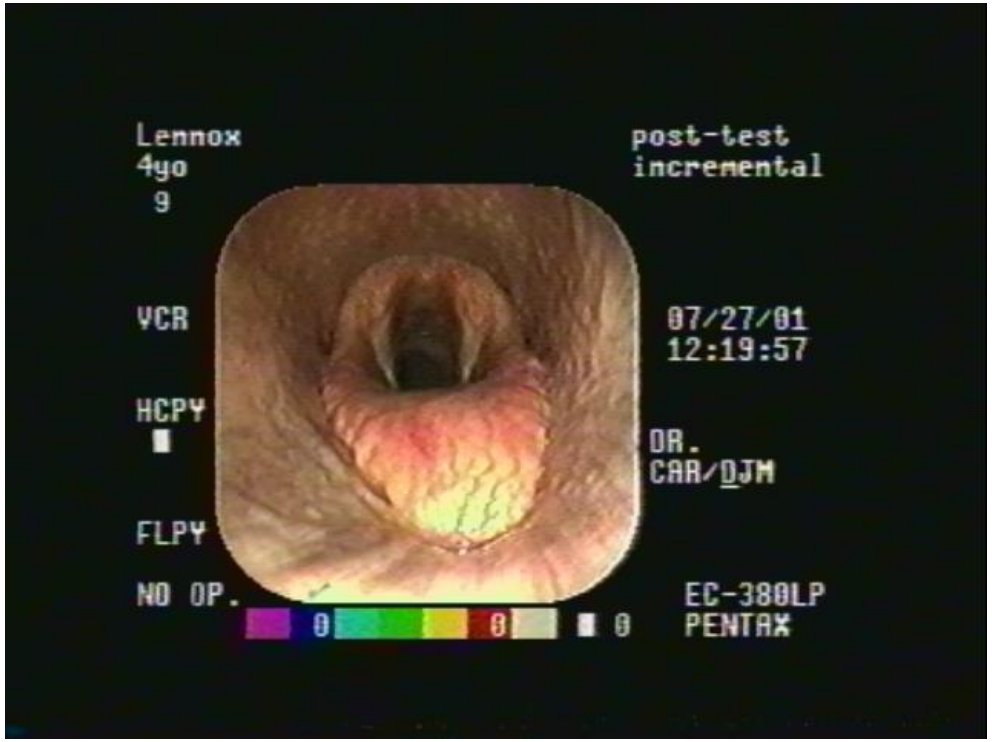
Warming
Humidifying

Turbinates



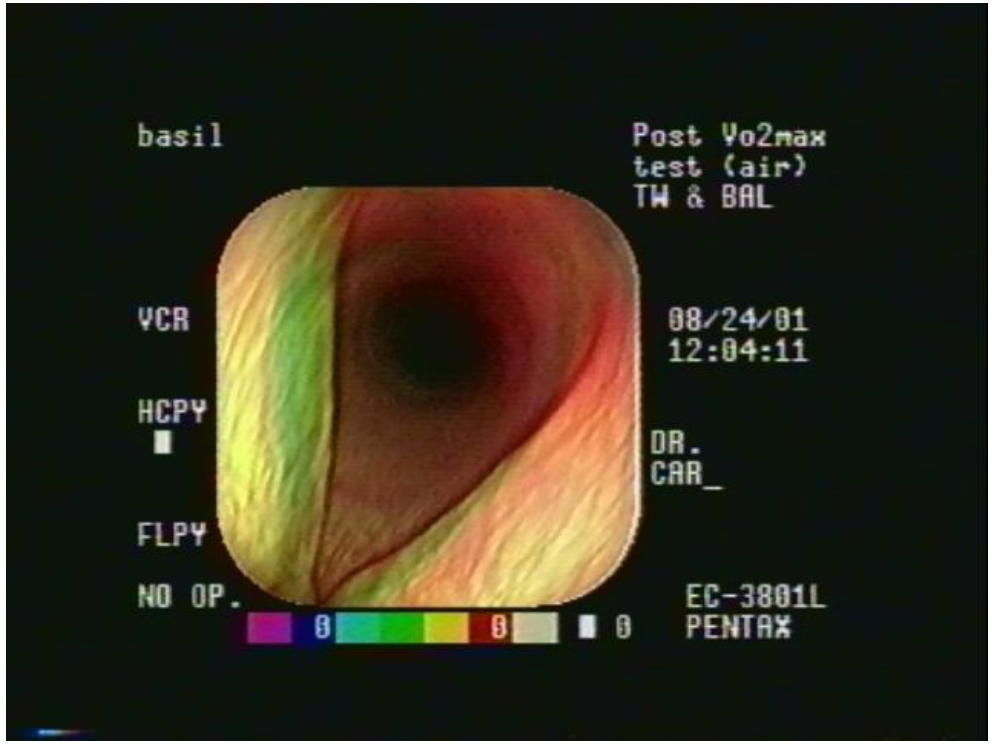
Pharynx



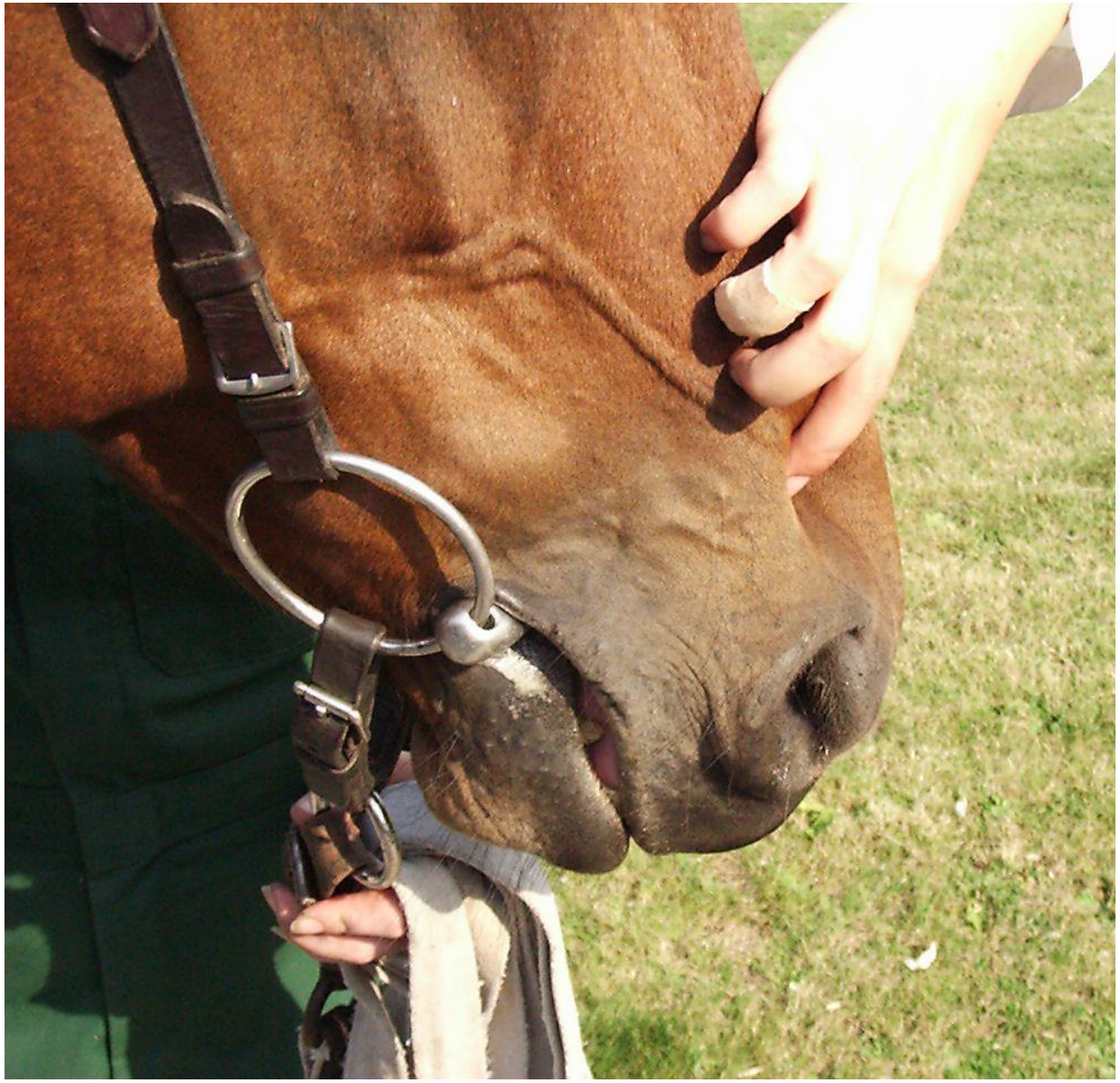

Lennox
4yo
9
post-test
incremental
VCR
07/27/01
12:19:57
HCPY
DR.
CAR/DJM
FLPY
NO OP.
EC-380LP
PENTAX

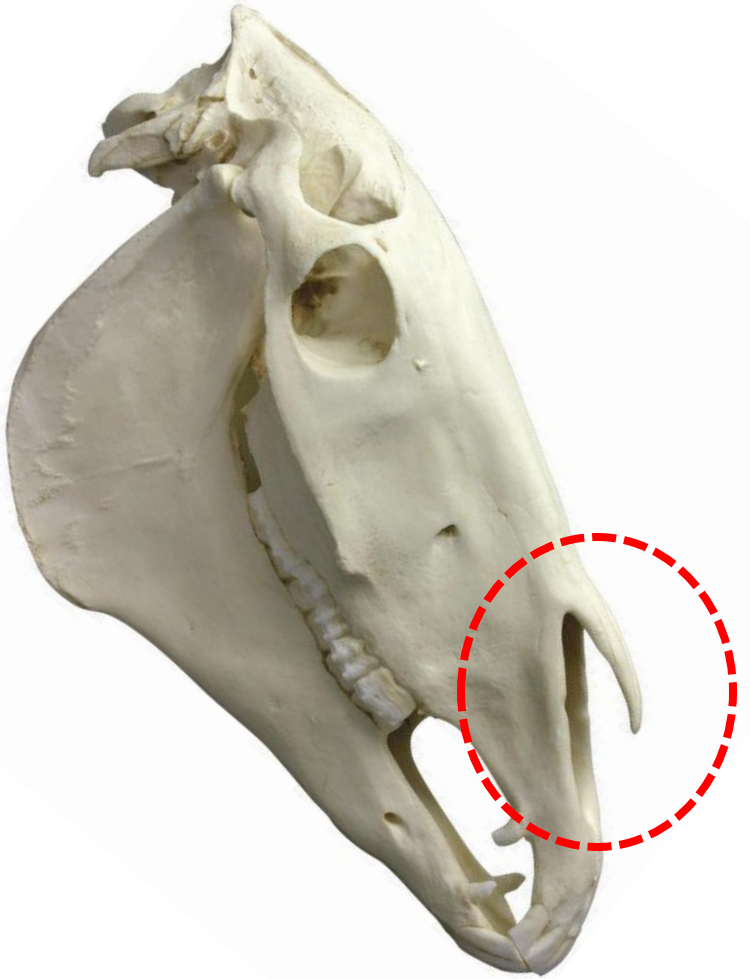
Larynx




basil
Post Vo2max
test (air)
TW & BAL
VCR
08/24/01
12:04:11
HCPY
DR.
CAR_
FLPY
NO OP.
EC-3801L
PENTAX

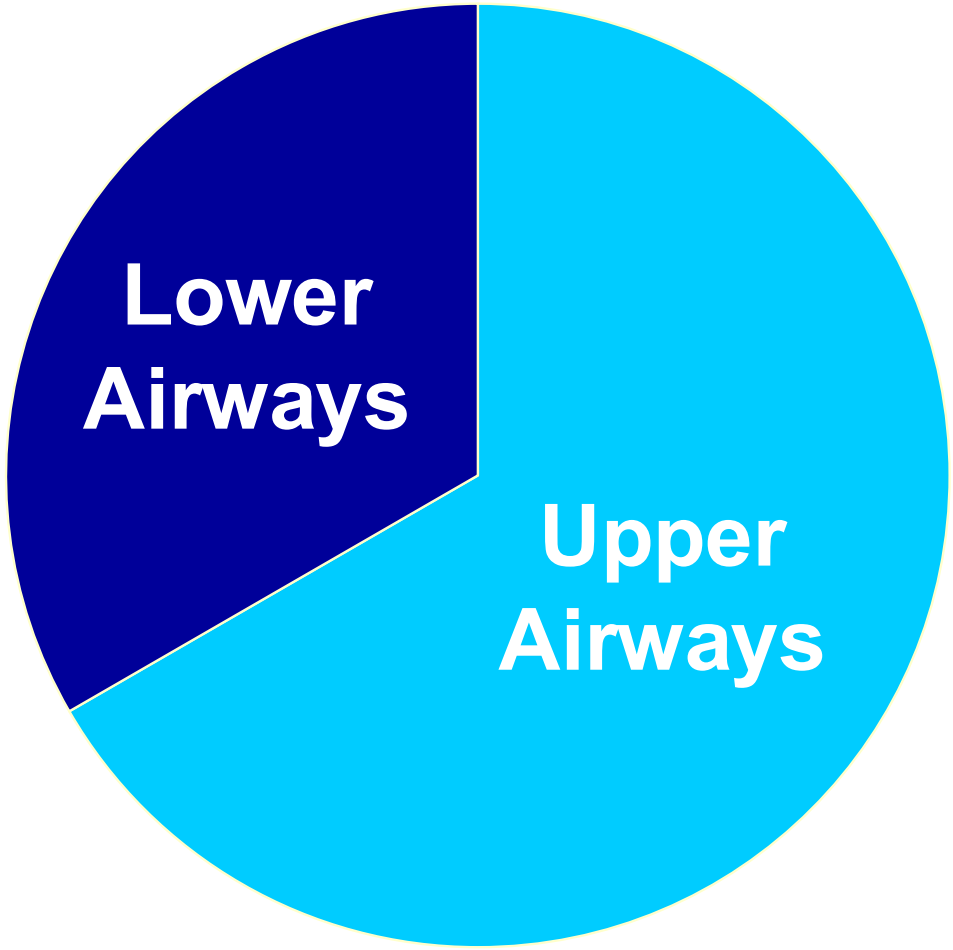
Most Resistance to Air Movement is in the Upper Airway

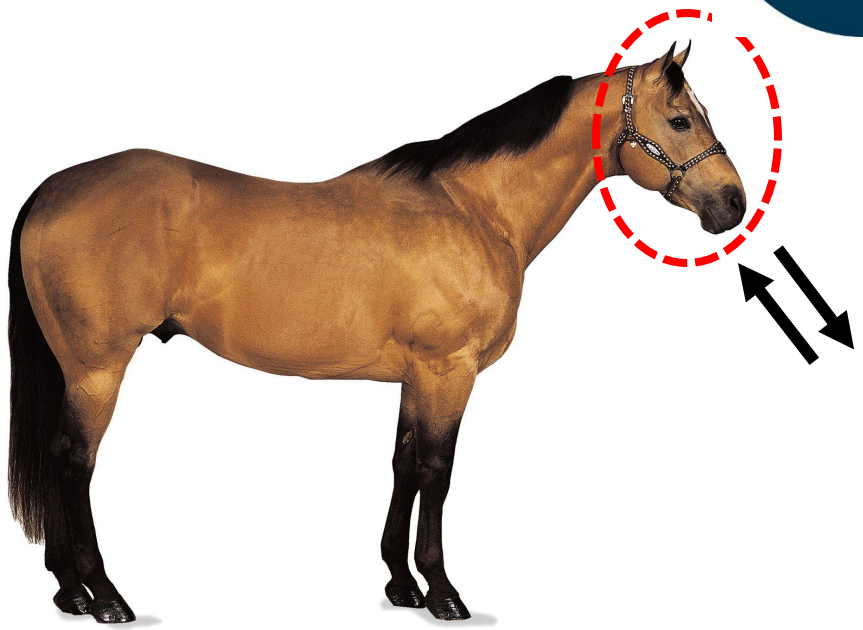




Where is the Resistance to Air Movement?

RESTING



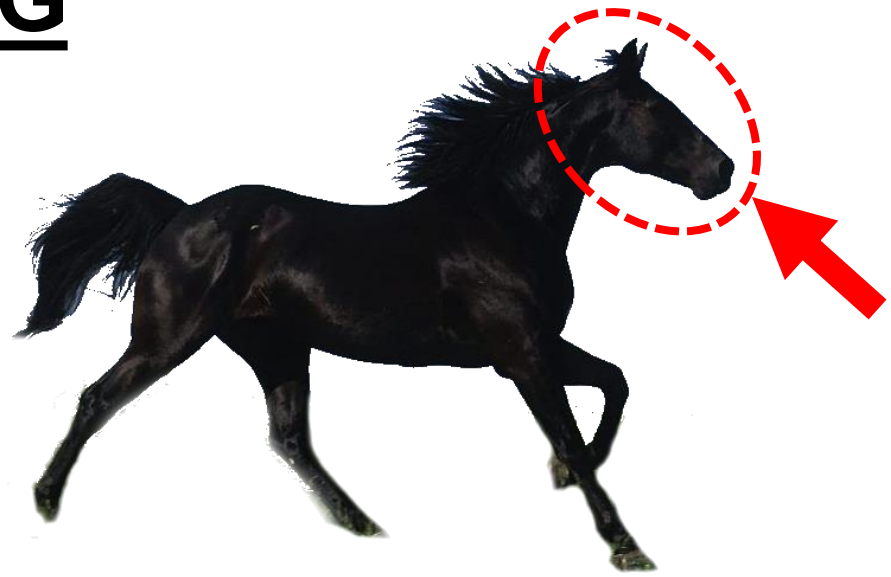


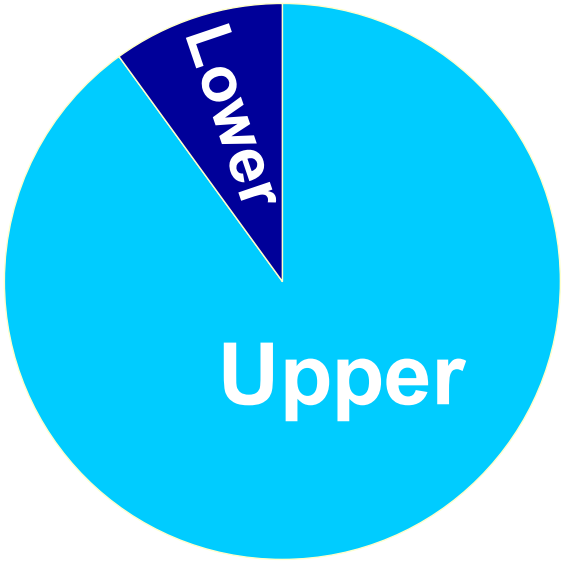
The majority of the resistance to airflow at REST is in the upper airways during both INHALATION and EXHALATION

Where is the Resistance to Air Movement?

EXERCISING

Inhalation

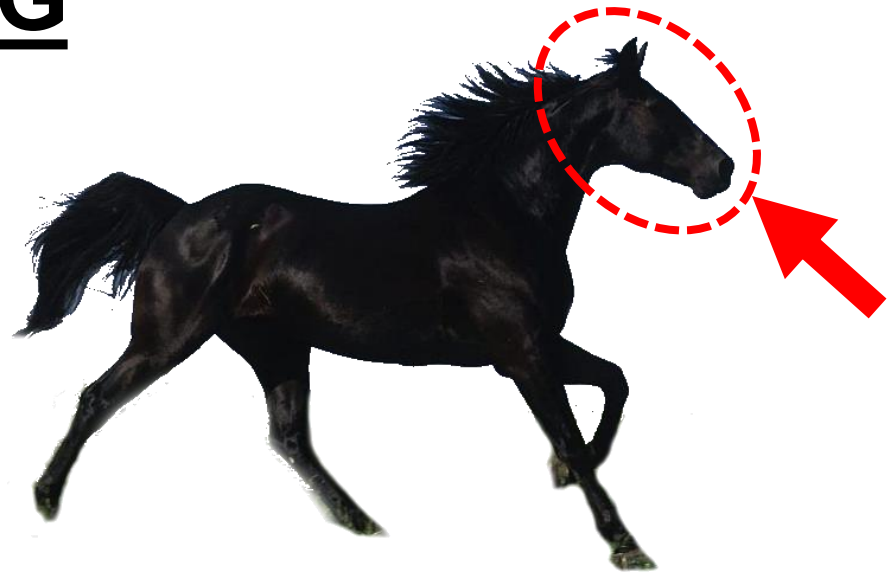


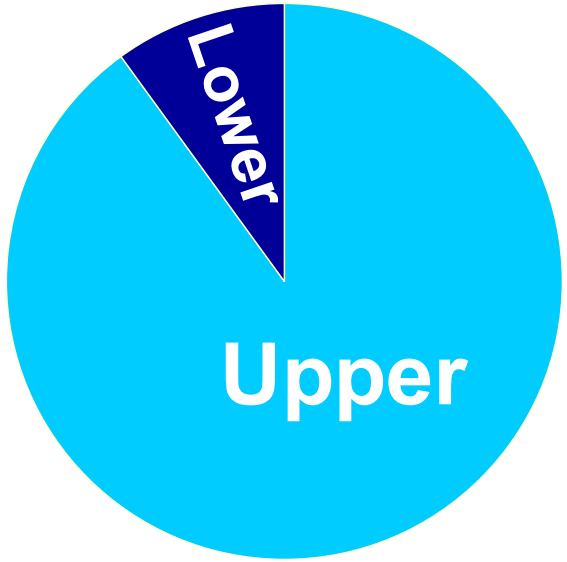


Where is the Resistance to Air Movement?

EXERCISING

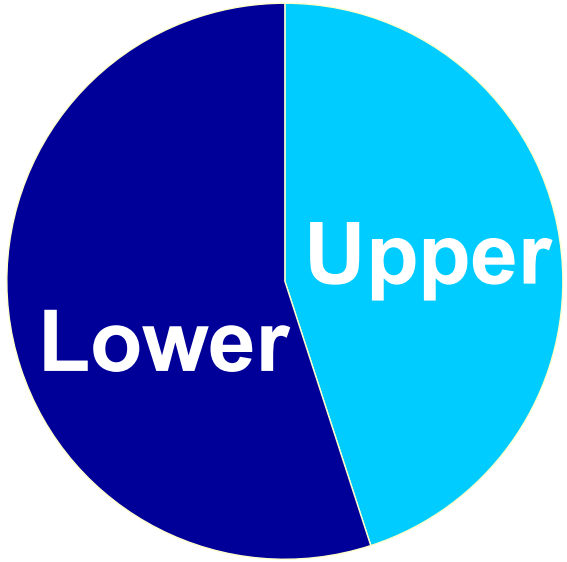
Inhalation





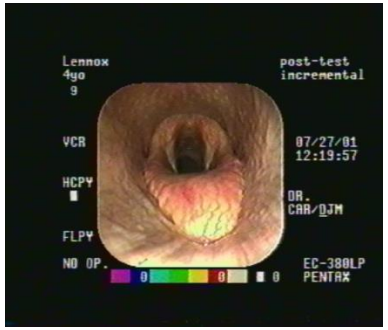
Exhalation



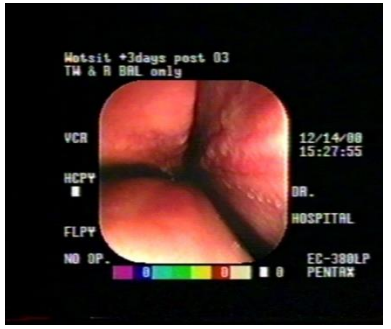




Larynx

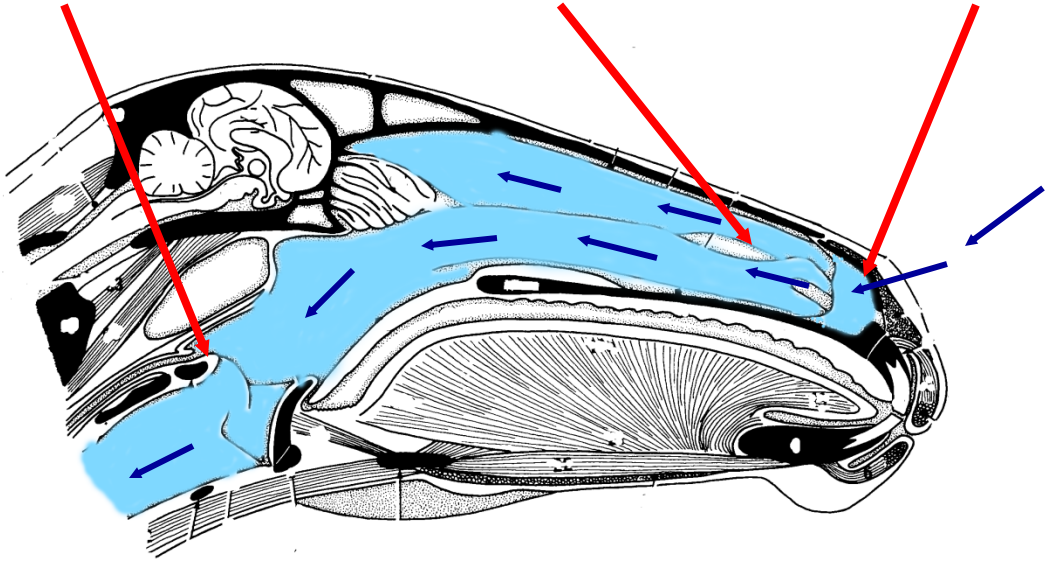


Turbinates



Nostrils





= where air flows

Upper Airway Dysfunction

“Roaring” Laryngeal hemiplegia

“Gurgling” DDSP

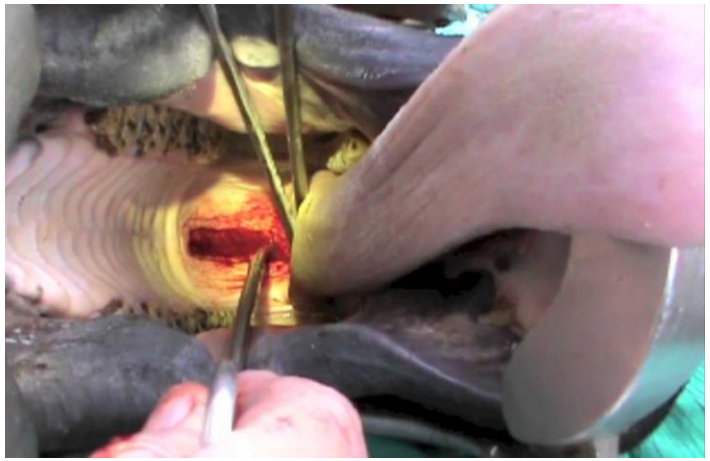


Straightforward to diagnose





Treatment Options





Oxygen

Carbon Dioxide

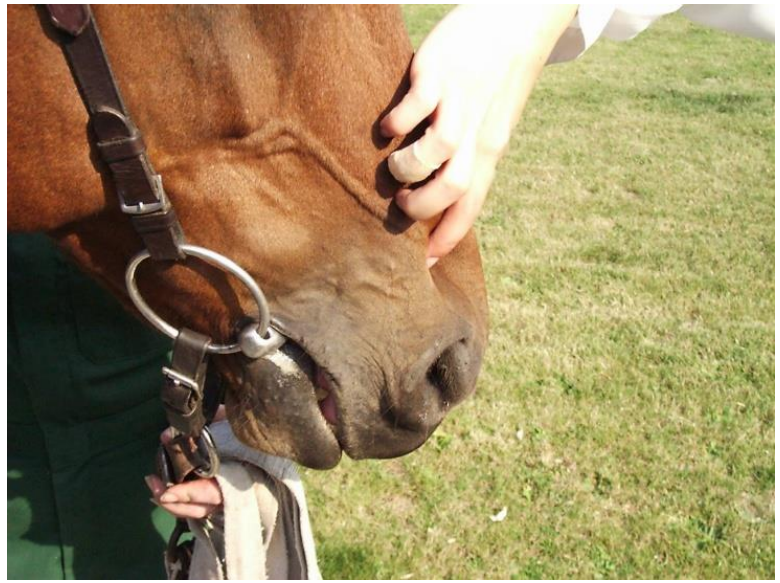
Of the TOTAL ENERGY a horse uses during CANTER or GALLOP, 10-20% is used to move AIR in and out of the LUNGS!

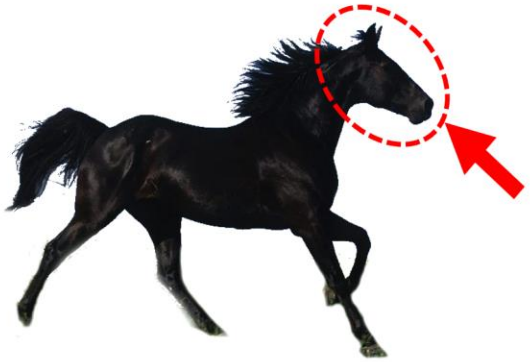


Oxygen

Carbon Dioxide

If we reduce the energy used for breathing, that leaves more energy for muscle contraction….





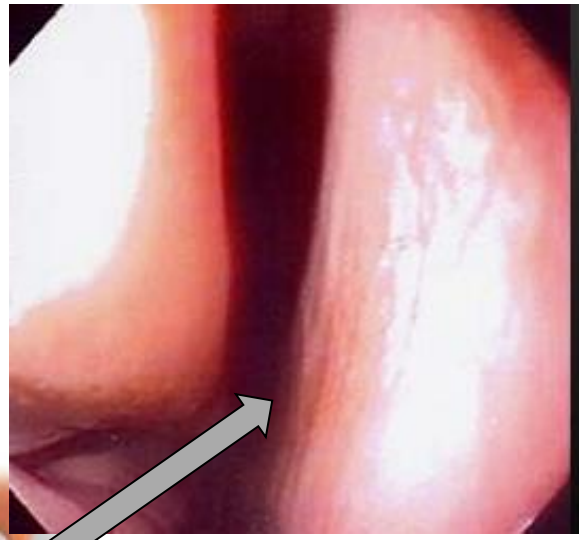

Lower
Upper



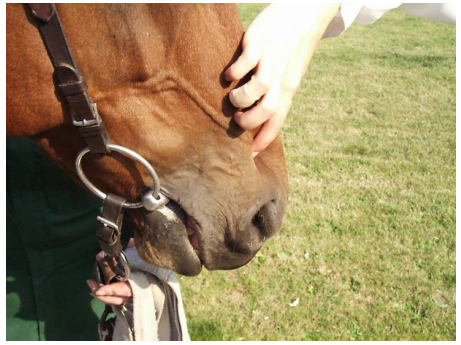



PROTECT YOUR HORSE
PERFORM YOUR BEST
FLAIR
EQUINE NASAL STRIPS
GENTLY ADHERES TO THE NOSE AND SUPPORTS NASAL PASSAGES
Breathe easier
• Reduce fatigue
• Conserve energy
DRUG FREE











Flair Nasal Strips prevent the inward collapse of skin and reduce upper airway resistance – make it easier to move air in and out!

The lungs are the 3rd biggest organ in the body of the horse

No.1: Skin



No.2: Digestive Tract



No.3: Lungs



Breathing, Oxygen & Performance







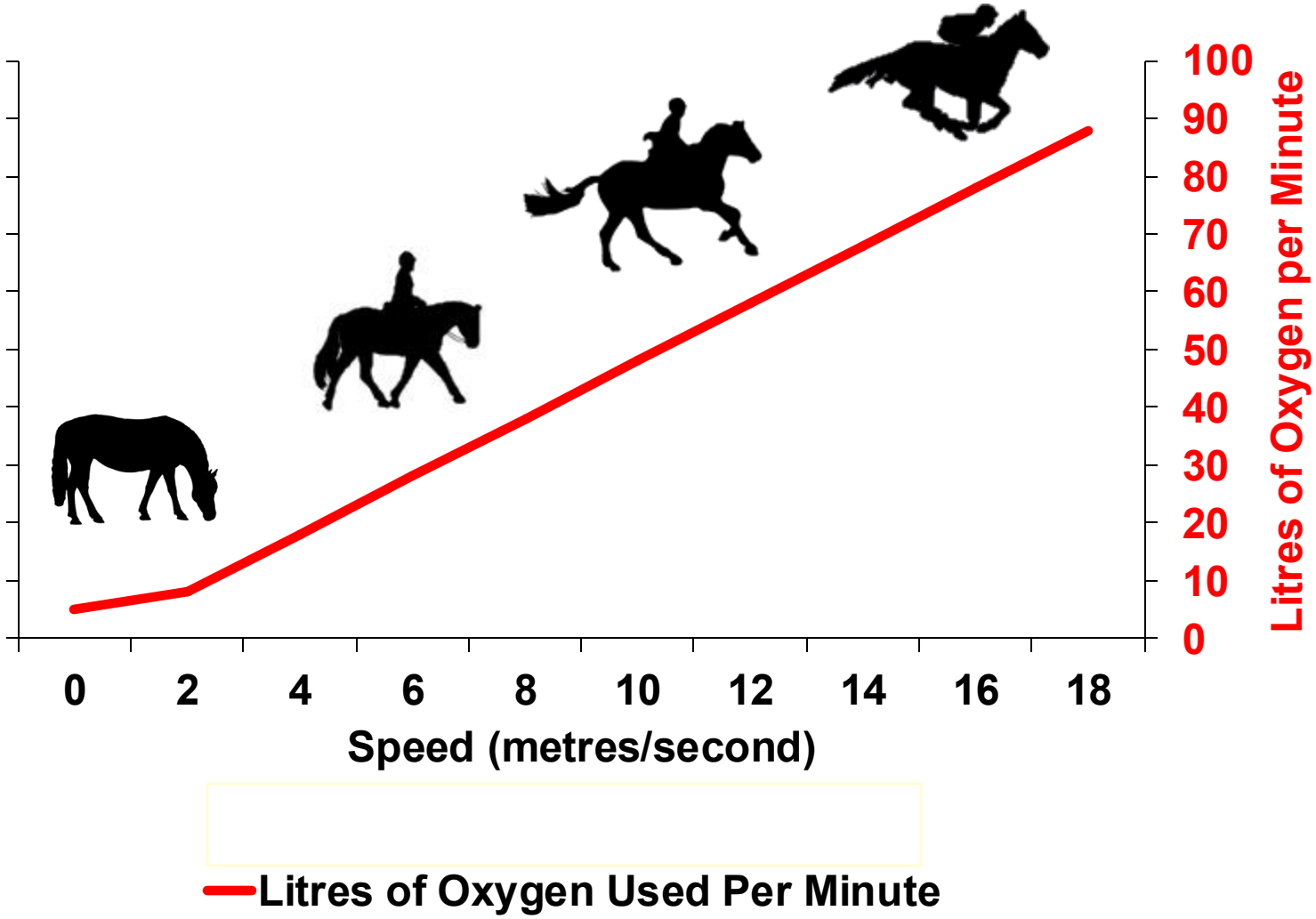




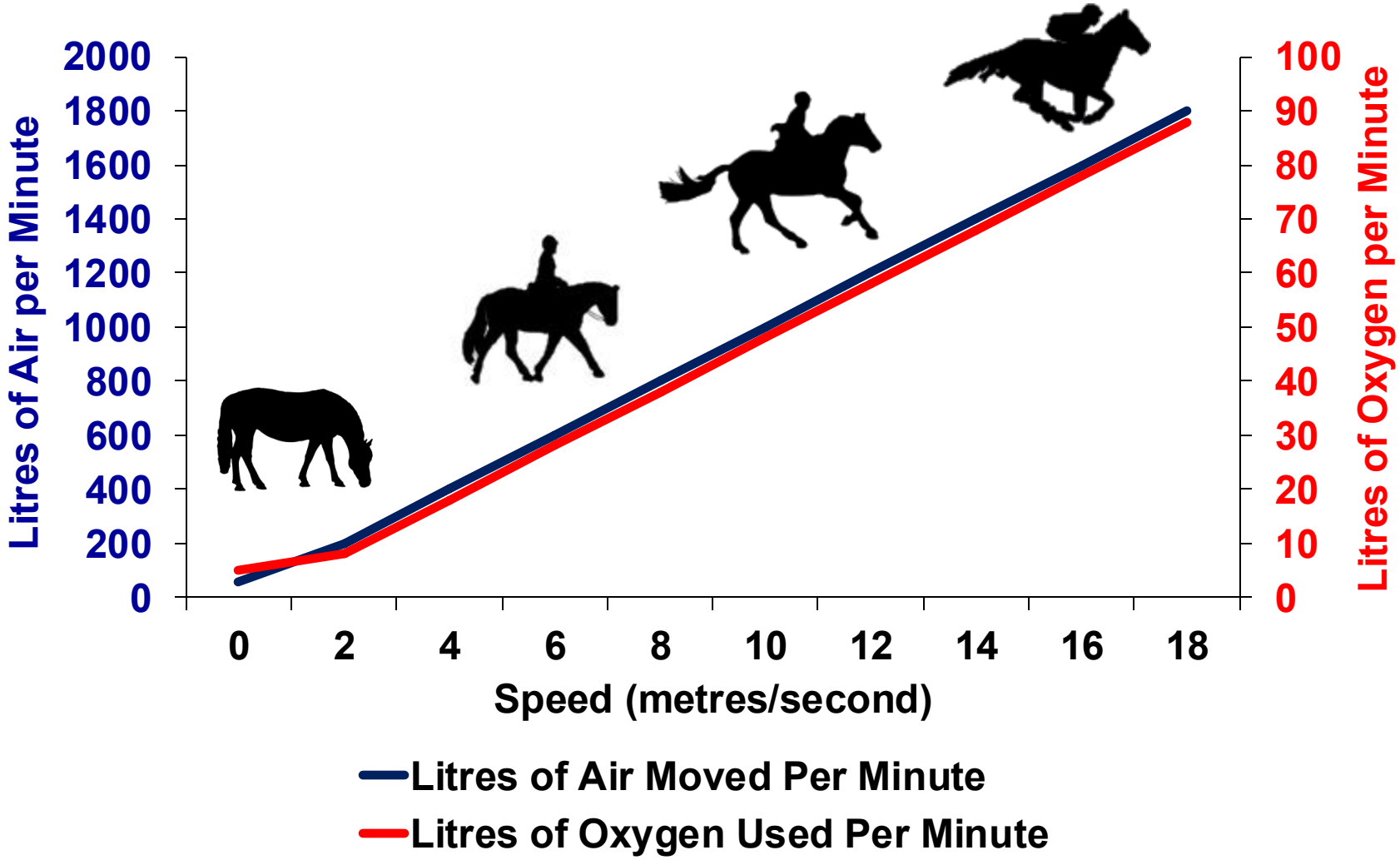




The harder a horse works the more OXYGEN it uses



The harder a horse works the more AIR it moves in and out



Breathing during exercise – at the limit!





Two buckets of air moved
IN & OUT
every SECOND

Breathing during exercise – at the limit!





Six baths of air moved
IN & OUT
Every MINUTE

Breathing during exercise – at the limit!





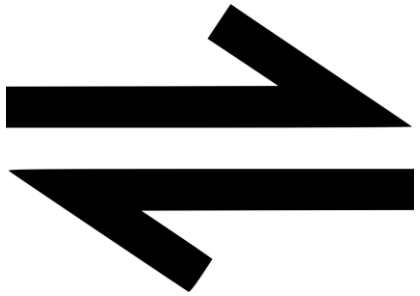
Air reaches speeds 3x faster than water flowing from a fire hose at maximum expiration

At Canter and Gallop Breathing and Stride are linked 1 to 1



1 Breath







1 Stride



110 – 170 STRIDES per minute

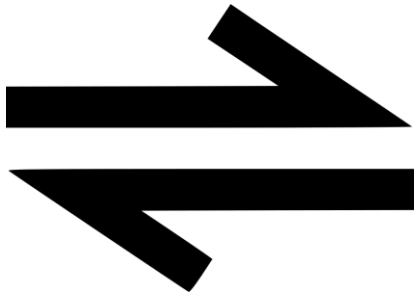
110 – 170 BREATHS per minute

At Canter and Gallop Breathing and Stride are linked 1 to 1



1 Breath







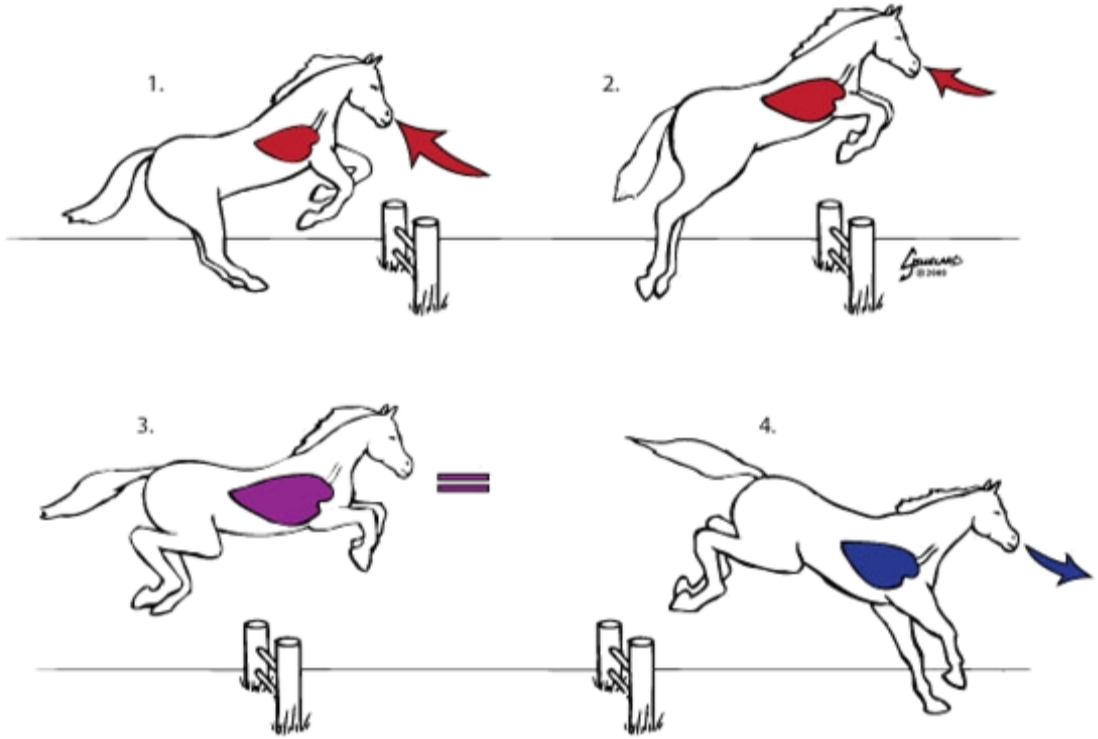
1 Stride



Anything that limits STRIDE (e.g. lameness) limits BREATHING

Anything that limits BREATHING, limits STRIDE

The horse is unable to move air in and out during about 1/3rd of a show jumping round i.e. when IT'S IN THE AIR!





When jumping, ***a horse holds its breath while in the air.***

Begins to breathe out when the forelegs hit the ground **on the other side of the jump.**

What limits performance?



What limits performance in horses?

Untrained/Unfit



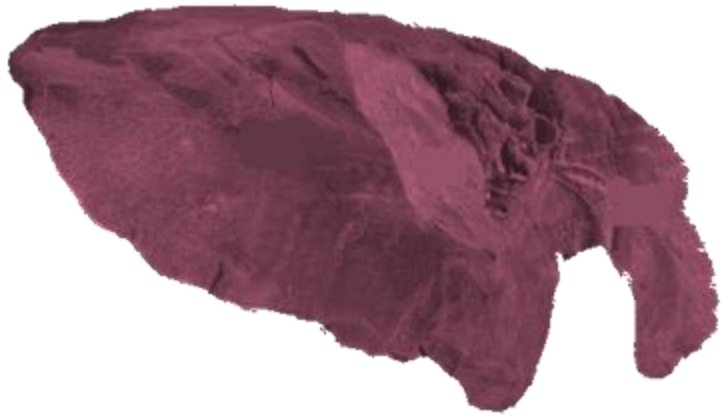


What limits performance in horses?

Untrained/Unfit



Trained/Fit





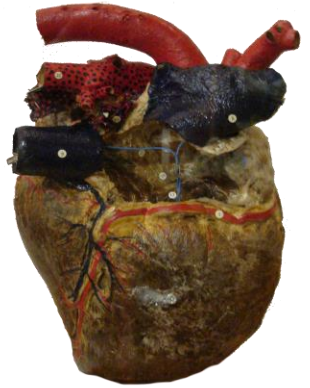
Why?

Untrained/Unfit



Training Adaptation

Trained/Fit



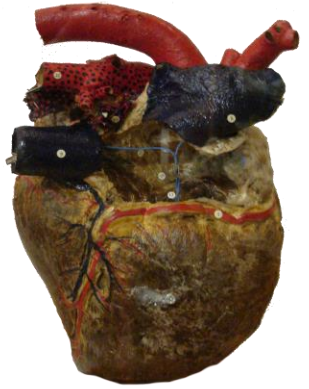
Why?

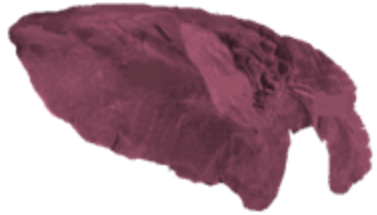
Untrained/Unfit

Trained/Fit

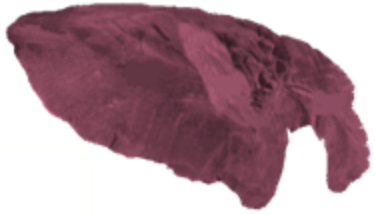


Training Adaptation





No Change



YOU CAN'T TRAIN BREATHING!

How do we know the lungs limit performance?

Oxygen in air = 21%



How do we know the lungs limit performance?



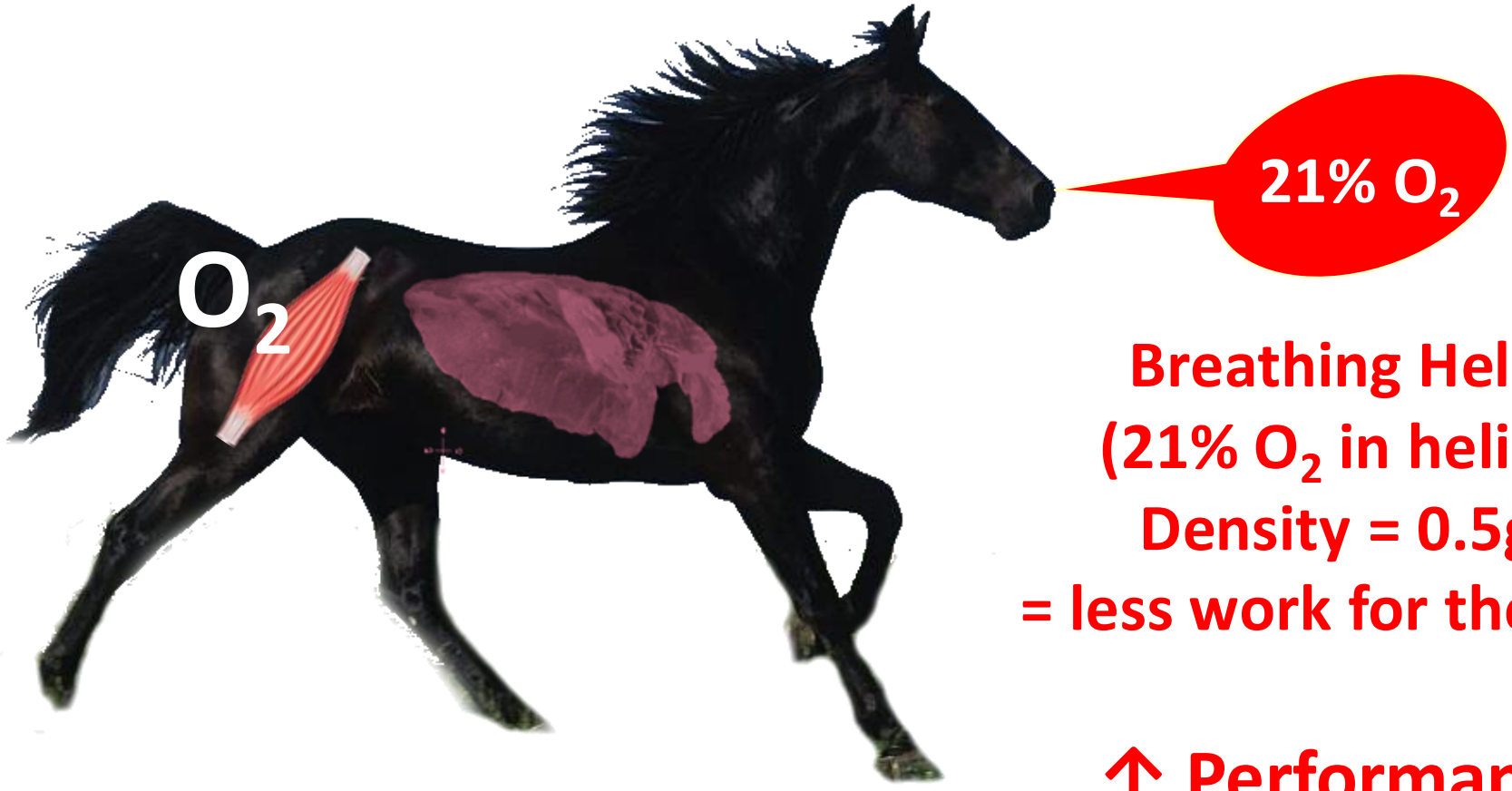
Oxygen in air = 21%

30% O_2

If we give 30% O_2 then the heart can pump it and the muscles can use it!

↑ Performance!

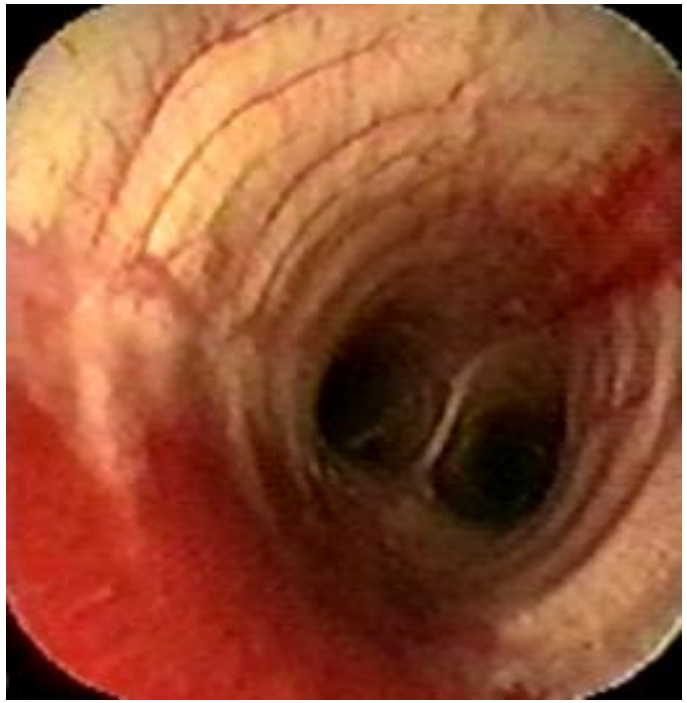
How do we know the lungs limit performance?

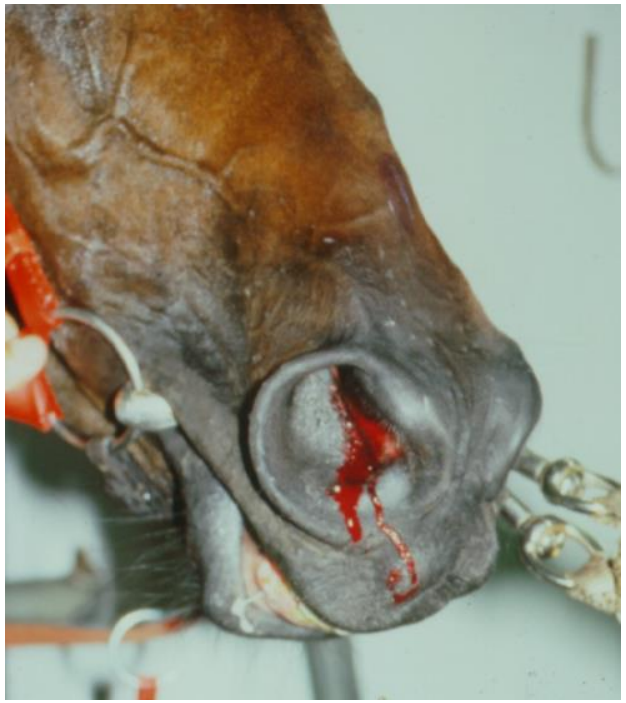


Breathing Heliox
(21% O_2 in helium)
Density = 0.5g/l
= less work for the lungs

↑ Performance!

What is Exercise-Induced Pulmonary Haemorrhage? EIPH





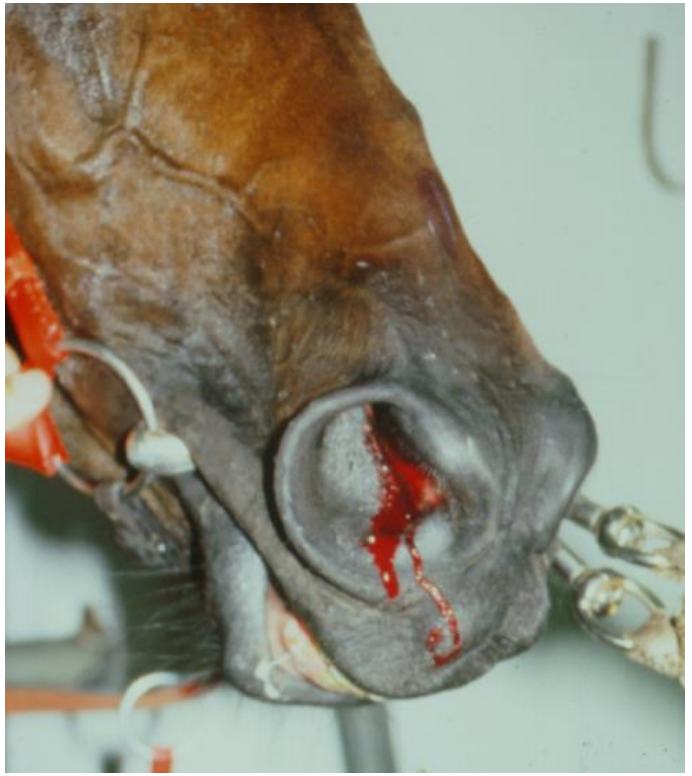
- “Bleeding”
- “Bleeders”
- “Lung bleeding”
- “Broken blood-vessels”

Blood in the airways or at the nostrils (epistaxis) after exercise

Animalweb

What is Exercise-Induced Pulmonary Haemorrhage? EIPH





Epistaxis in racehorses: ~1-2 per 1000 starts

Animalweb

What is Exercise-Induced Pulmonary Haemorrhage? EIPH







Endoscopic EIPH in racehorses: 40-70%

Animalweb

What is Exercise-Induced Pulmonary Haemorrhage?
EIPH







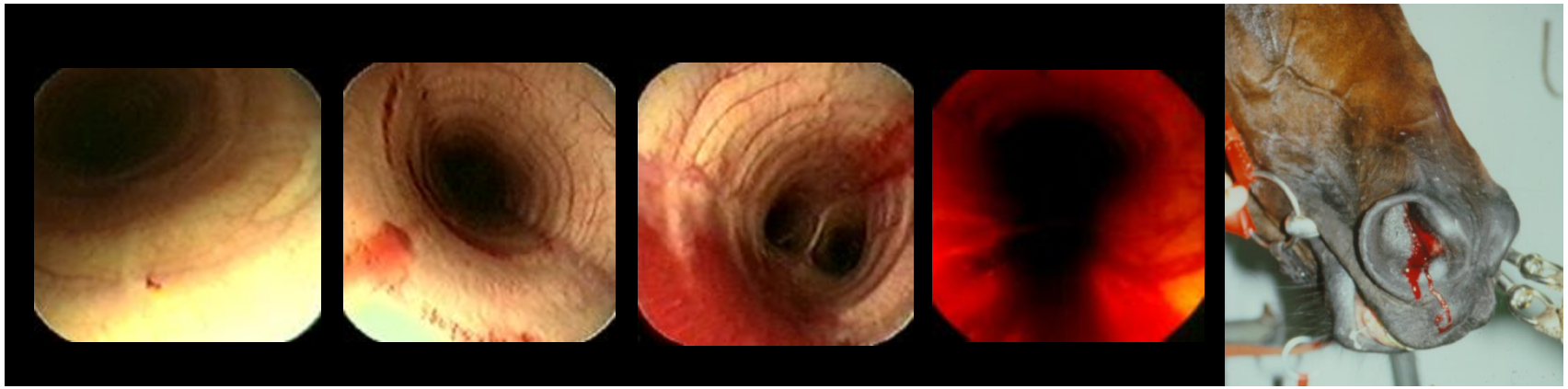
Endoscopic EIPH in racehorses: 40-70%

BUT if the scoped on 3 separate occasions = 100%

Animalweb

Severity varies from mild to severe…





mild

severe

Which type of horses get EIPH?

- Three-Day Event Horses
- Polo Ponies
- Show Jumpers
- Endurance
- Draught horses
- Reining
- Roping
- Cutting
- Barrel racing
- Carriage driving



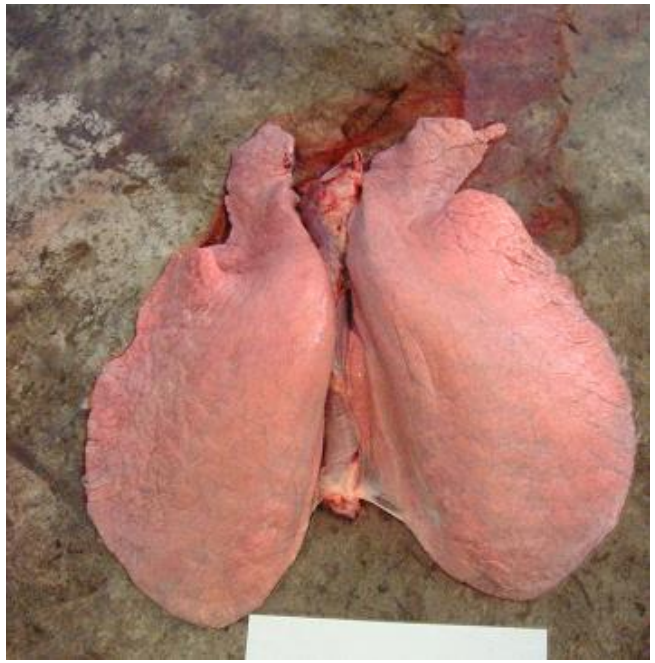




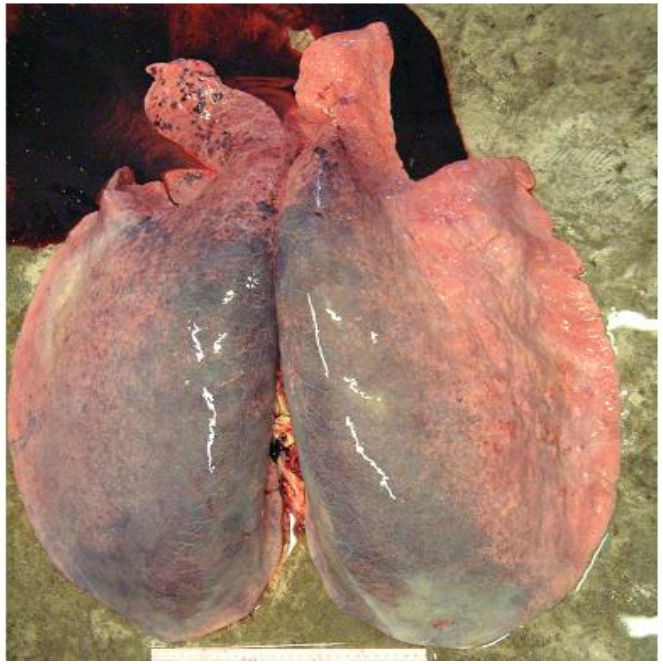




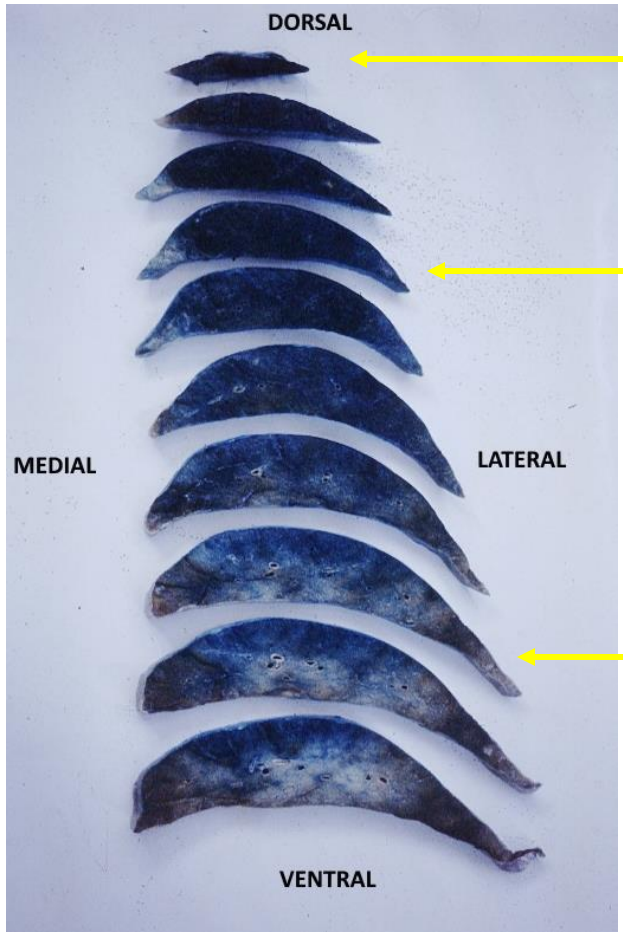
EIPH causes irreversible damage to the lungs

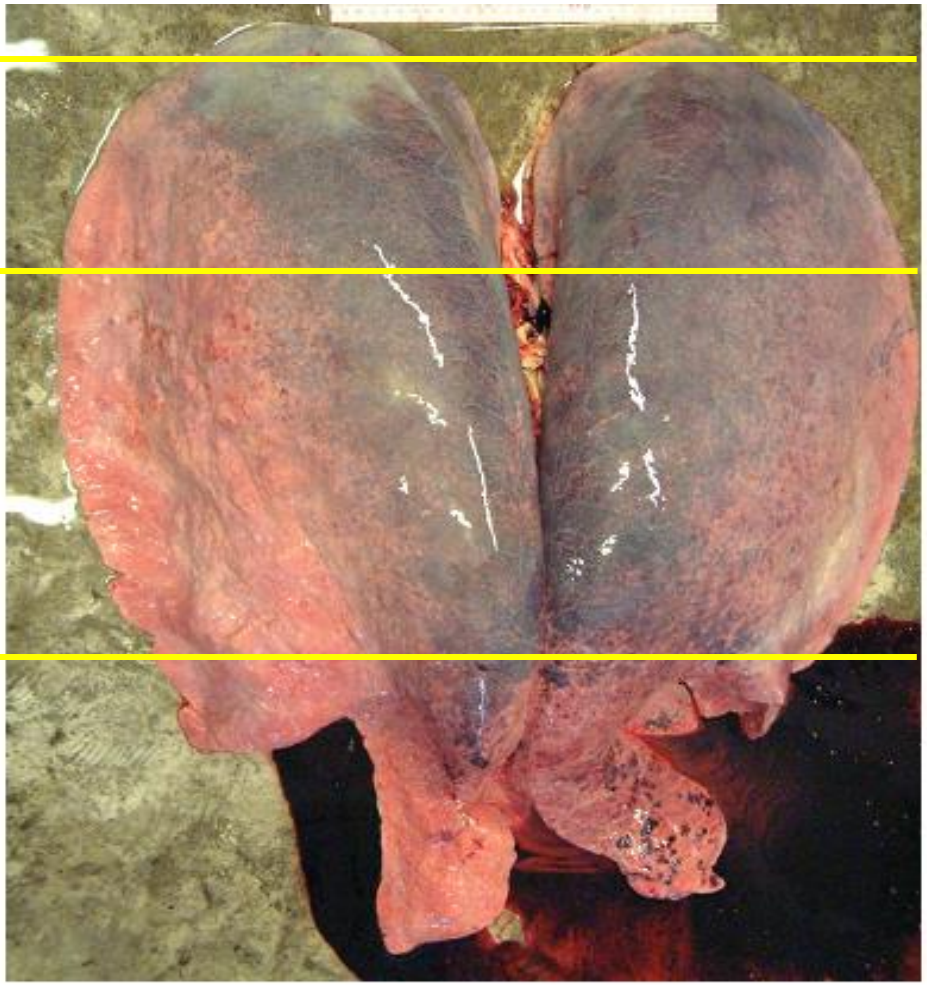






EIPH causes irreversible damage to the lungs

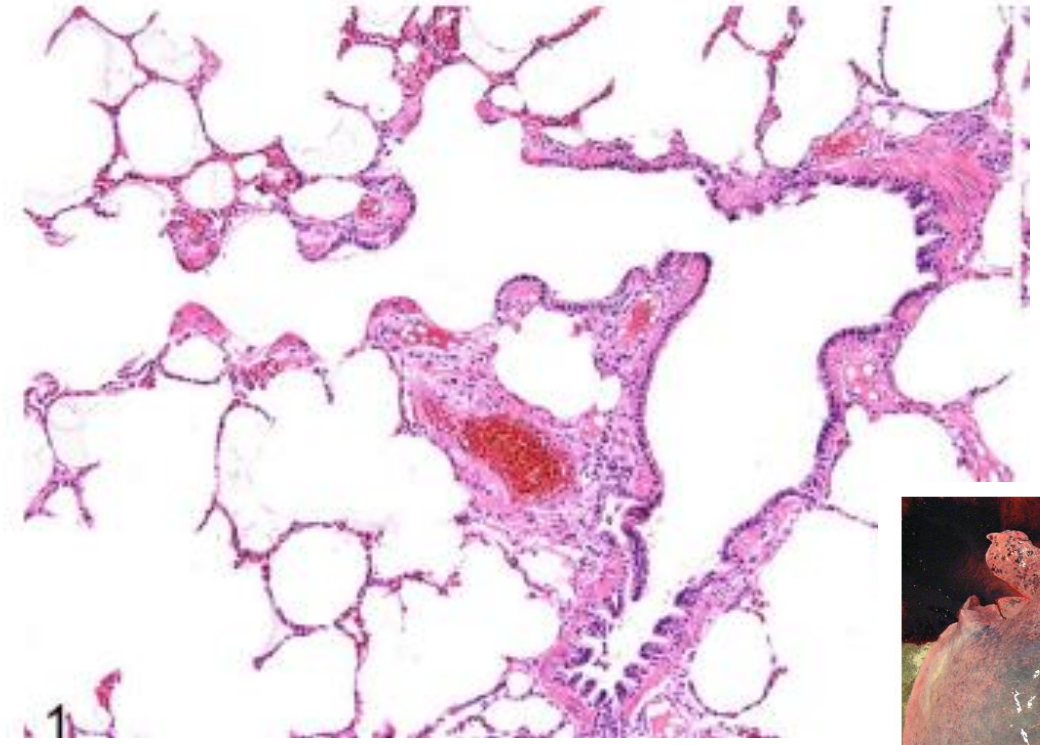




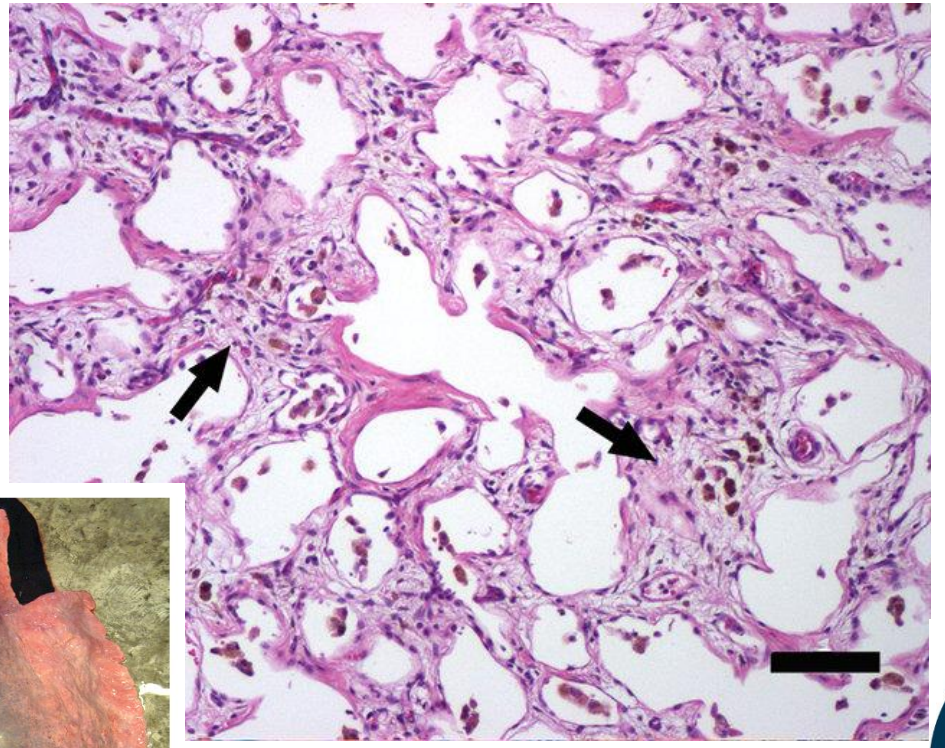
Animalweb

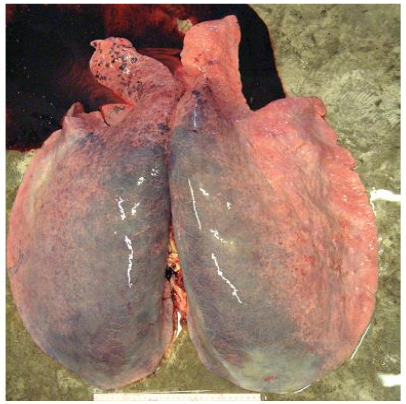
Lung damage due to EIPH

Healthy equine lung tissue



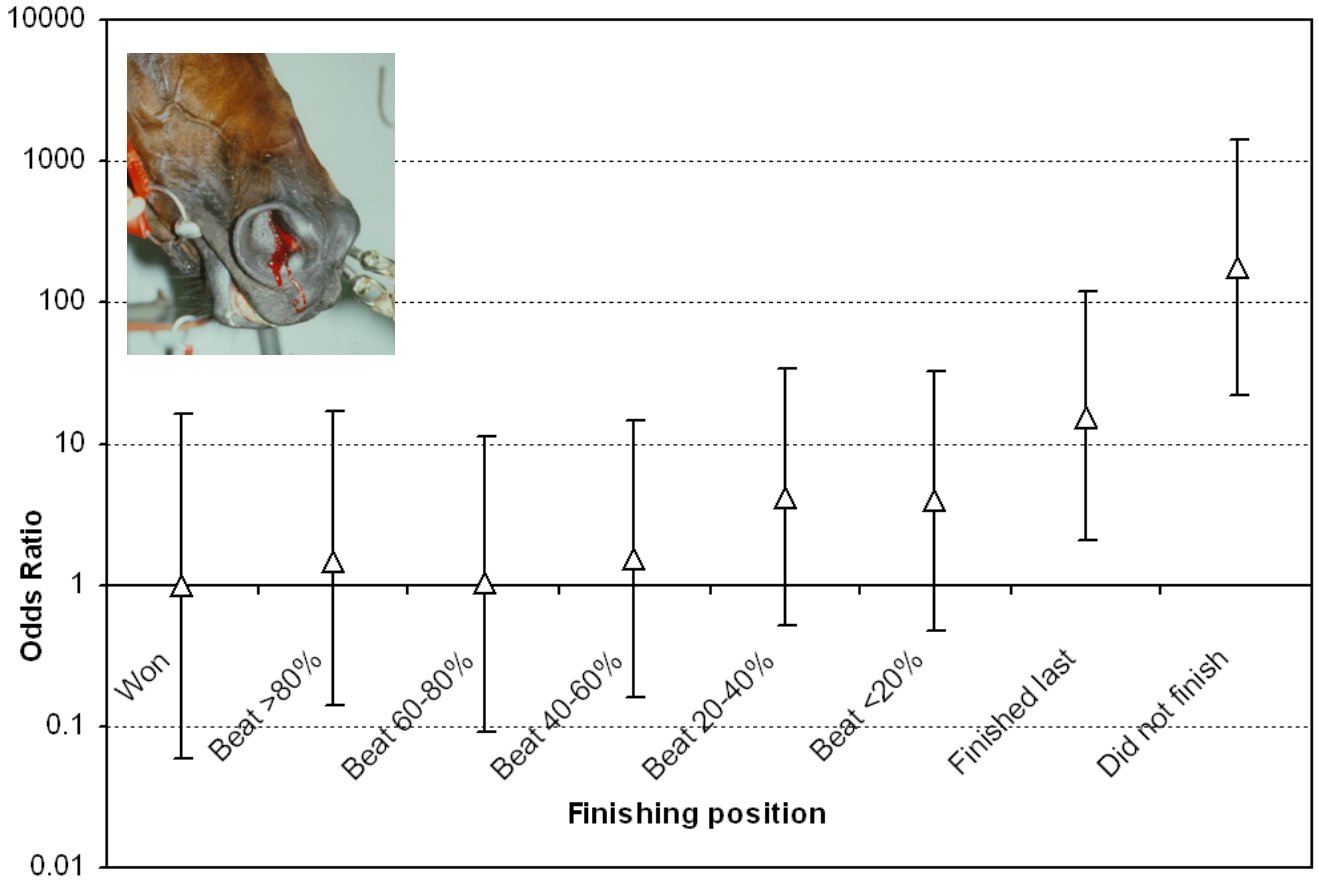
EIPH damaged equine lung tissue





Animalweb

Effect of epistaxis on racehorse performance



Worsening performance

- Horses with epistaxis 20x more likely to finish last
- Horses with epistaxis 200x more likely to not finish

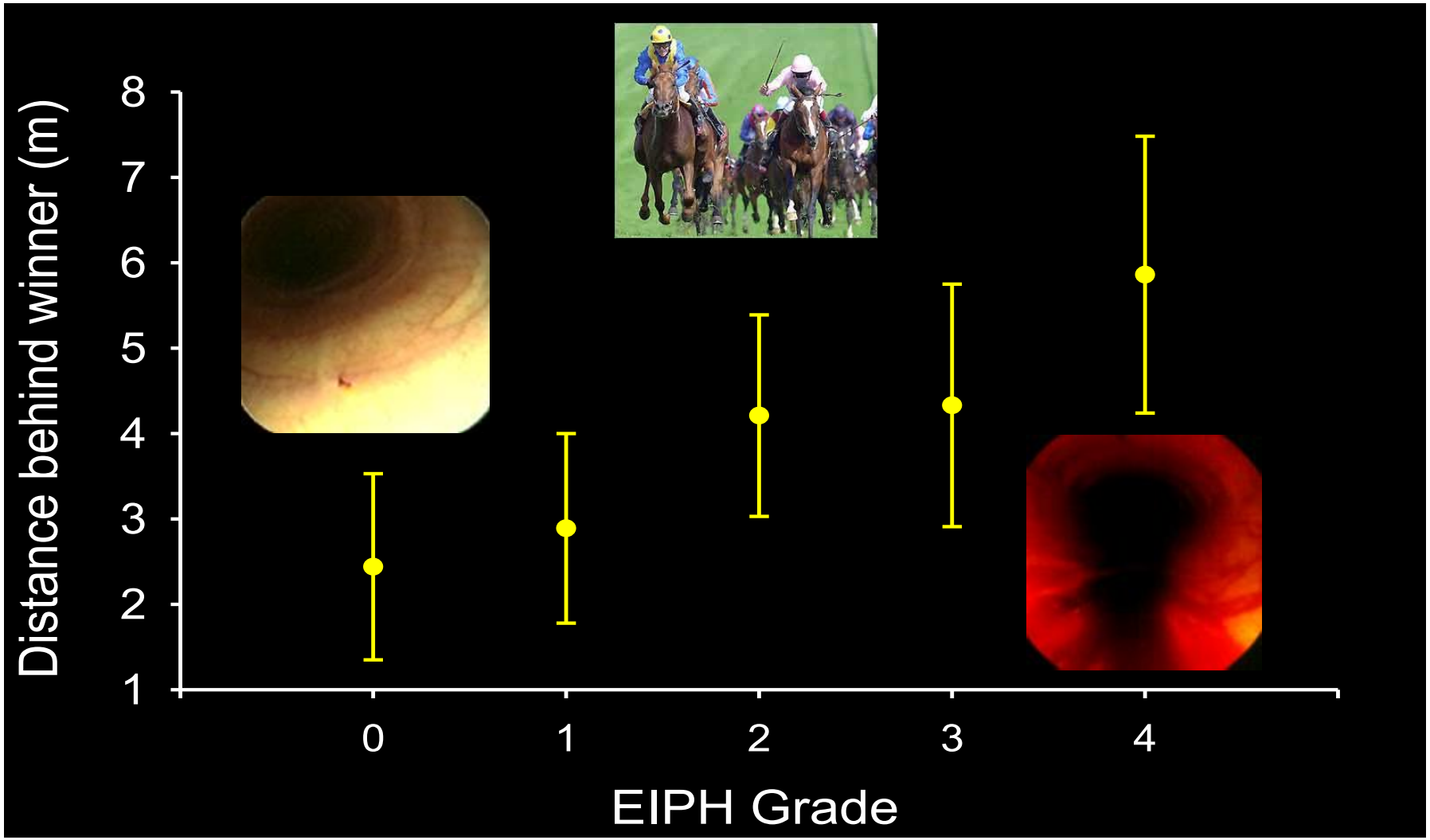
Equine Veterinary Journal BEVA

Risk factors for epistaxis on British racecourses: evidence for locomotory impact-induced trauma contributing to the aetiology of exercise-induced pulmonary haemorrhage

J. R. NEWTON, K. ROGERS, D. J. MARLIN, J. L. N. WOOD, R. B. WILLIAMS

First published: 05 January 2010 | https://doi.org/10.2746/042516405774480049 | Citations: 23

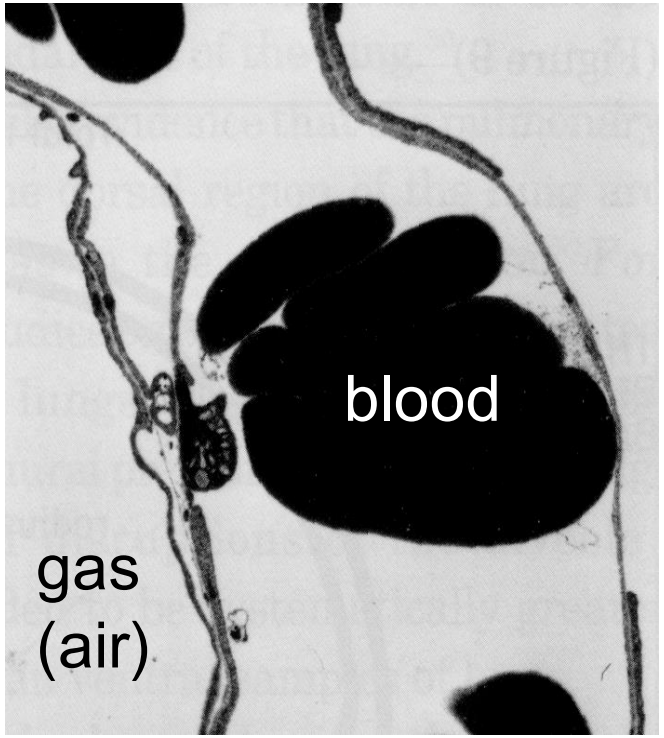
Increasing EIPH = further behind the winner!



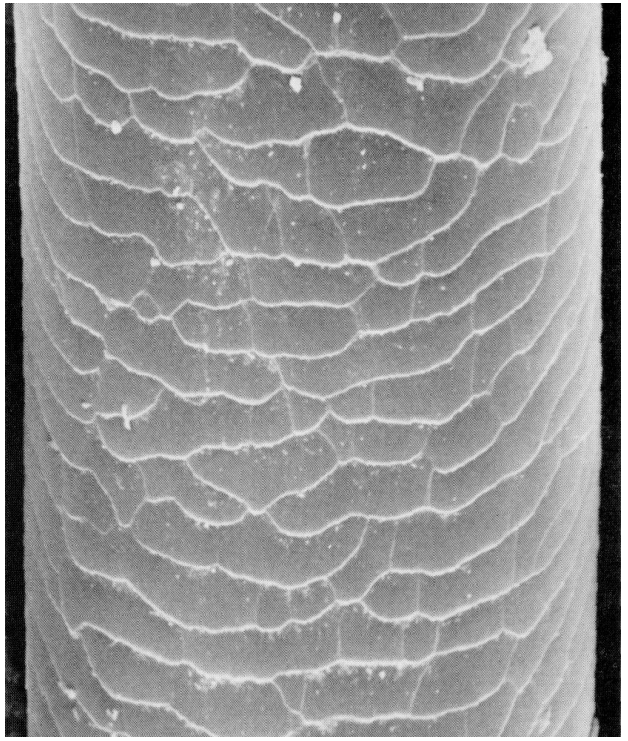
Hinchcliff *et al.* (2005) Association between exercise-induced pulmonary hemorrhage and performance in Thoroughbred racehorses. JAVMA

Why do horses bleed in the lungs?

Blood-Gas Barrier



Human Hair



- Thin membrane separating air and blood
- High lung blood pressure
- High physical stress on lung tissue
- Locomotory trauma
- Respiratory disease
- Pollution
- Cold air

Goals in Management of EIPH

- Reduce level of bleeding
- Improve performance
- Decrease lung damage

<u>Prevention is not a realistic goal</u>

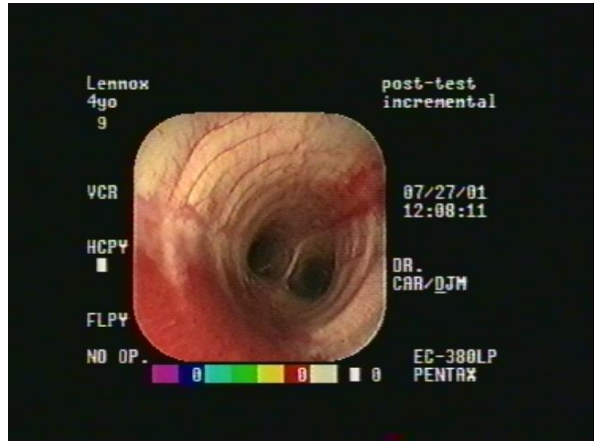


What makes bleeding worse in some horses on some occasions?

• High blood pressure	Yes
• Heart disease	Yes
• Arrhythmia (AF)	Yes
• Inflammation	Yes
• Infection	Yes
• Excitement	likely
• Climate	likely
• Genetics	likely
• Altitude	possibly
• Pollution	possibly
• IAD	possibly
• Upper airway obstruction	possibly
• Extreme going	possibly
• Jumping	possibly

Lots of Treatment for EIPH

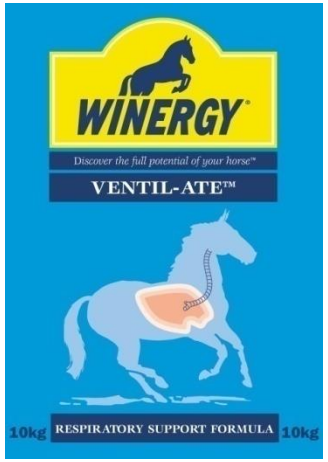
- Furosemide
- Nasal Dilator Strips
- Omega 3
- Immunomodulators
- Nitroglycerin
- Inhaled Nitric oxide (NO)
- Phlebotomy
- Water deprivation
- PDE inhibitors
- Clenbuterol
- B_2-agonists
- Ascorbic acid
- Equiwinner patches
- Snake venom











Treatment of EIPH

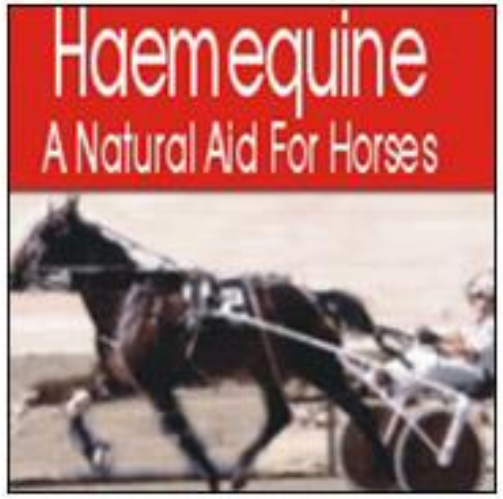
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- B_2-agonists
- Ascorbic acid
- Equiwinner patches
- Snake venom

Only 1 treatment that prevents EIPH completely 100% of the time……



Not tested – No evidence of efficacy















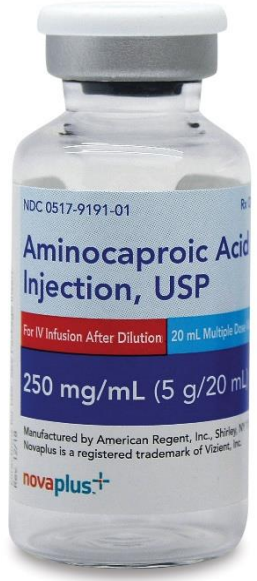


No current evidence for efficacy but widely used……



- Nitrovasodilators
  - Nitric oxide (inhaled) – worsens EIPH
  - NO donors e.g. L-arginine
- Anti-fibrinolytics
  - Amicar (aminocaproic acid) - reduces performance; no effect on EIPH
- Tranexamic acid
- Guanabenz
- Clonidine
- ACE inhibitors (enalapril)
- PDE inhibitors
- Human Leukocyte Elastase/Protease Inhibitor
- Endothelin-1 antagonists
- Haemostatics > Carbazochrome (“Kentucky Red”)





Some evidence for efficacy

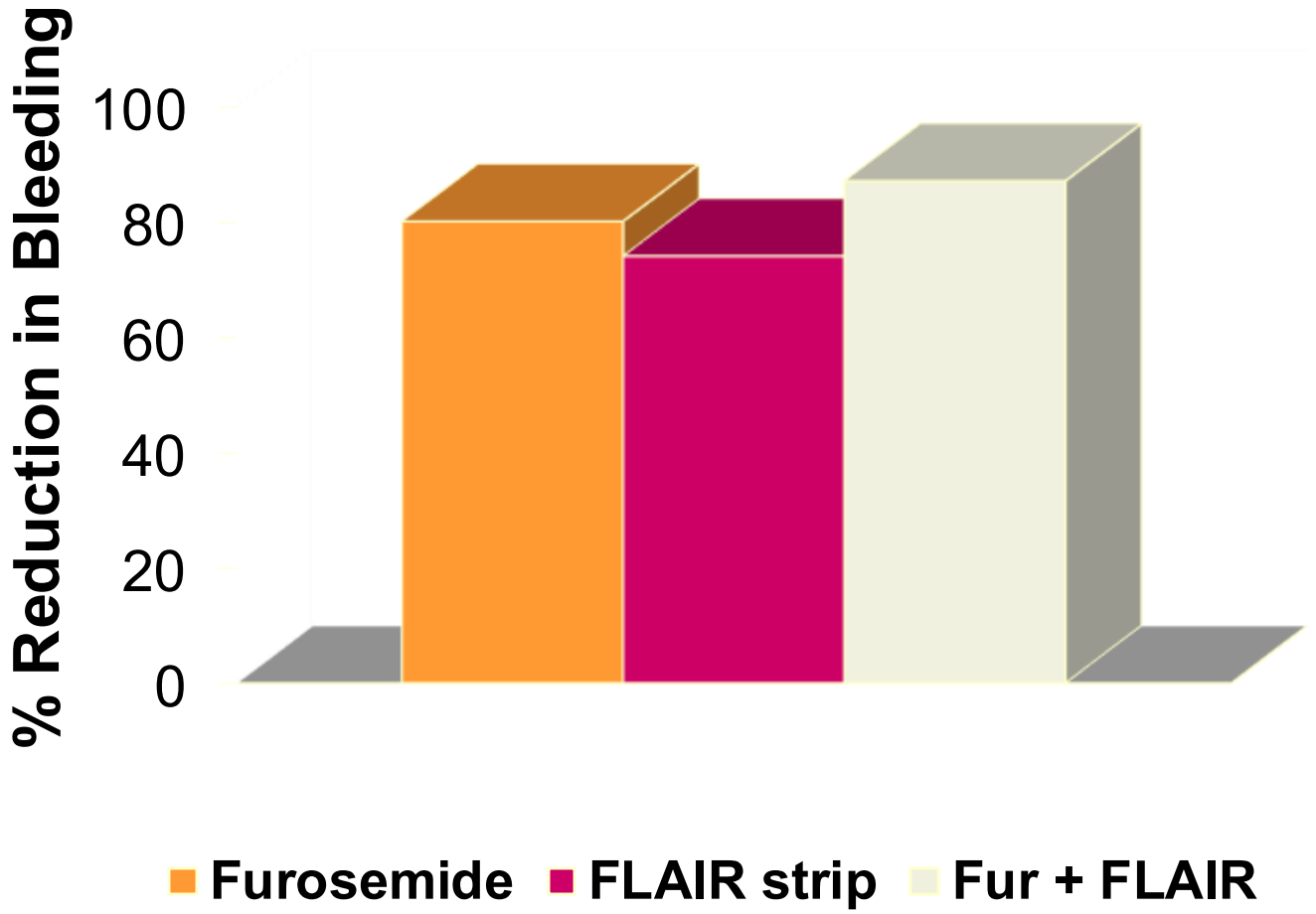
- Omega-3’s
- Concentrated equine serum
- Corticosteroids & bronchodilator
- Phlebotomy
- Water deprivation!





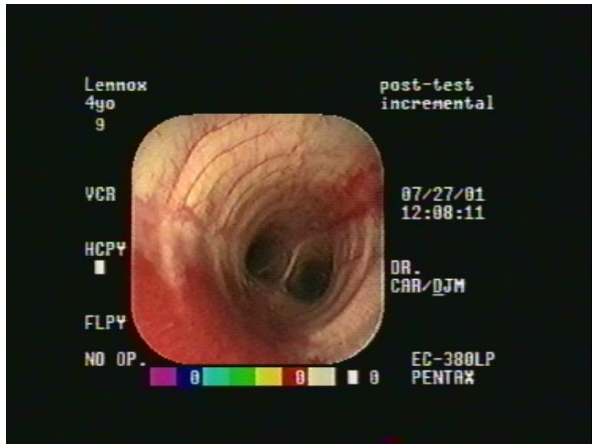


FLAIR nasal strips and Lasix reduce bleeding!



Treatment of EIPH







Lasix has been shown to reduce the severity of EIPH when used ONCE! Horses develop tolerance to Lasix the more its used! i.e. it becomes LESS effective

Being mechanical, there is no evidence that the efficacy of the Flair Nasal Strip declines with repeated use!

Is the horse badly designed if the respiratory system is the weakest link and prone to injury?





Is the horse badly designed if the respiratory system is the weakest link and prone to injury?





Is the horse badly designed if the respiratory system is the weakest link and prone to injury?





How can you support your horses' respiratory system?

- Don't ignore a cough
- Low dust bedding
- Soaked feeds
- Soaked or steamed forage or haylage
- Regular 'scoping
- Don't work hard in very cold weather
- Flair strips – reduce respiratory load, support upper airway function and reduce lung damage from EIPH!



How can you support your horses' respiratory system?

- Flair reduces the load on the respiratory system
  - Physiological demand> airflow, resistance, etc
- Flair in turn reduces stress on the respiratory system
  - Consequences of load> airway collapse, EIPH, work of breathing
- Flair delays the onset of respiratory fatigue
  - Reduced nasal resistance = reduced respiratory load

