Classic case:
- 8 year old horse with exercise intolerance, coughing during exercise, mucopurulent nasal discharge
- Hypertrophy of the external oblique and rectus abdominus muscles (the so-called “heave line”)
- Also called “Heaves”, chronic obstructive pulmonary dz (COPD)

Presentation:
- Signalment and History
  - Adult horses > 7 years old
  - No sex predilection
  - Hereditary: polygenic trait in certain horse families
  - Exposure to organic dust: molds (poorly cured hay), mites, endotoxins (common)
  - Signs wax and wane in response to season, specific feed/allergen exposure
  - Most severe in hot, humid weather
  - Northern USA, Europe: primarily stabled horses
  - Southern USA: more prevalent in horses on pasture, Summer/Fall
- Remission: indistinguishable from healthy non-affected horses
- Mild disease
  - Afebrile
  - Mild exercise intolerance
  - Cough during exercise
  - Mucopurulent nasal discharge
  - Exaggerated end-expiratory effort in a resting horse
  - Respiratory rate normal or tachypnea
- Severe chronic cases
  - Marked exercise intolerance
  - Weight loss
  - Nostril flaring
  - Cachexia
  - Reluctance to move
  - Chronic cough
  - Mucopurulent exudate
  - Abnormal lung sounds
  - Heave line

DDX:
- Inflammatory airway disease, bronchopneumonia, pleuropneumonia, viral respiratory tract infections, neoplasia, upper airway diseases, exercise-induced pulmonary hemorrhage, *Dictyocaulus arnfieldi* (lungworm)
Test(s) of choice:

- **Thoracic Auscultation (at rest with rebreathing bag)**
  - Expiratory wheezes and crackles, tracheal rattles
  - Adventitious sounds restricted to one lung region in some
  - Over-inflated lung field on percussion

- **Tracheobronchial aspirate**
  - Non-degenerate neutrophils (neuts)
  - Excessive mucus

- **Bronchoalveolar lavage**
  - Non-degenerate neutrophilic inflammation
  - Clinically healthy horses:
    - 60% macrophages, 35% lymphocytes, <10% neuts,
    - <2% mast cells, <1% eos
  - Severe heaves:
    - Non-degenerative neutrophils > 50% of WBCs trapped in mucus background
    - +/- Pollen, fungal hyphae, Curschmann’s spirals (inspissated mucus plugs)

- **Arterial blood gas analysis**
  - Hypoxemia (decreased PaO$_2$)
    - Magnitude related to dz severity
    - Due to ventilation/perfusion mismatch
  - Chronic cases (increased PaCO$_2$)

- **Bronchodilator test**
  - Administer atropine (0.02 mg/kg IV once)
    - If RAO, marked improvement of clinical signs observed
    - Pneumonia does not respond significantly

- **Pulmonary function testing (treadmill with endoscopy)**
  - Decreased airway dynamic compliance
  - Increased pulmonary resistance
  - Large change in transpulmonary pressure during respiration
  - **Endoscopy**: Excessive mucopurulent tracheal exudate from both lung lobes

- **Skin allergy testing, serum antibody testing**
  - Generally unrewarding in identifying offending allergens
  - Have greater antibody responses and skin test reactions to environmental allergens

- **Hematology**
  - Usually unremarkable
  - Helps detect secondary bacterial infection (Increased WBC, fibrinogen)

- **Radiographs**
  - Early disease: unremarkable
  - Progressive disease: Bronchointerstitial pattern

- **Ultrasound**
  - Little value in diagnosing RAO
  - Used to rule out other respiratory diseases (pneumonia, pleuropneumonia)
Rx of choice and Prevention:

Goal:
- Minimize exposure to allergens/irritants
- Control airway inflammation
- Relieve airflow obstruction

- Environment changes: Most important factor for long-term control of heaves
  - **Strict compliance essential**
    - Clinical signs commonly improve in 3-5 days
    - Some individuals take 3-4 weeks or longer for complete recovery
  - **Decrease exposure to dust**
    - Essential for long-term control of heaves
  - **Pasture-associated heaves**
    - Change to different pasture OR
    - Move indoors to well-ventilated stall
  - **Heaves associated with indoor environment**
    - Complete turn out is critical factor
  - **Improperly cured hay and straw primary source of dust and molds**
    - **Feeding:**
      - Use complete pelleted feeds or hay cubes
      - IF pelleted feed unavailable, soak hay for 2 hours before feeding
        - May reduce nutrient value of hay
    - **Bedding:**
      - Avoid straw bedding
      - Use wood shavings, shredded paper, or peanut kernels
    - **Cleaning stall:**
      - Remove horse from stable when cleaning stall
      - Wet aisles before sweeping ground to decrease dust
    - **DO NOT store hay in barn**
Rx of choice and Prevention: (continued)

- **Medical Management**
  - **Corticosteroids** - contraindicated in horses predisposed to laminitis, with endocrinopathies, or with gastritis or gastric ulceration
    - Oral prednisolone (not prednisone)
    - Parenteral dexamethasone (Alternatively)
      - Indicated for horses in respiratory distress
      - Improves breathing within 6-8 hrs of administration
    - **Inhalant steroids:** fluticasone, beclomethasone
      - Used concurrently with oral or parenteral steroids
        - May not provide therapeutic benefit for 24-72 hrs
        - NOT first line of tx for horses in respiratory distress
  - **Bronchodilators**
    - Used in conjunction with corticosteroids
    - Three types of compounds used to relax airway smooth muscle
      - **β2 agonists:** clenbuterol, albuterol, salmeterol, fenoterol (most widely used)
        - Administer prior to steroid inhalant
          - Enhances steroid deposition in smaller airways
          - Relaxes airway smooth muscles
          - May stabilize mast cells
          - Increases mucociliary clearance
          - Decreases inflammatory cytokine production
          - Adverse effects: tachycardia, tachypnea, sweating, trembling
      - **Phosphodiesterase Inhibitors:** aminophylline, pentoxifylline
      - **Anticholinergics:** atropine, ipratropium bromide
        - (Emergency relief of airway obstruction)
        - Adverse effects: may cause colic, thickens airway secretions

- **Nasal oxygen** - 5-10 L/min improves arterial oxygen tension in severely affected horses

- **Acupuncture** - Has been shown to provide relief from bronchospasm

**Prognosis:**
- **Good:** with strict owner compliance
  - Life-long management
    - Horses do not “out-grow” RAO
  - Acute exacerbations will occur with
    - Husbandry practices lapse
    - Hot and humid weather conditions
  - Inflammation more difficult to manage as horse ages
**Pearls:**

- RAO is basically **recurrent allergen-induced neutrophilic inflammation of lower airway**

- In contrast, **Inflammatory Airway Disease (IAD) is**
  - A **non-septic** inflammatory disease
  - **Young performing horses < 5 years old**
    - 22-50% of Thoroughbred & Standardbred racehorses

- **Clinical Signs similar to RAO**
  - Mild exercise intolerance
  - Poor performance
  - Mild airway obstruction
  - Chronic cough during exercise
  - Excess airway secretions during exercise
  - Mucopurulent exudate
  - Crackles, wheezes ausculted with rebreathing bag
  - Multifactorial etiology
  - Not recurrent

- **Bronchoalveolar lavage: Critical in establishing diagnosis**
  - Mixed inflammation with high total nucleated cells
    - Mild neutrophilia (15%), lymphocytosis, monocytosis (most common)
    - Increased metachromatic cells (mast cells >2%)
    - Eosinophilic inflammation (>5%) Type I hypersensitivity reaction
      - **DDX:** ascarid larval migration, lungworm infection

- **Treatment the same as RAO**
  - With addition of:
    - Mast cell stabilizers (e.g., nedocromil sodium)
    - Low dose human interferon-α