# Code Blue!

## Respiratory Distress: triage, diagnostics and treatment options

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VCA Specialty Animal Hospitals

# OVERVIEW

- Triage and assessment
- Oxygen therapy
- Initial stabilization
- Causes of respiratory distress
  - Upper Airway
  - Lower Airway
  - Parenchymal
  - Pleural space
- Diagnostics and treatment


# Triage

# TRIAGE



- Be prepared
- Triage
  - To 'sort'
  - Prioritize patients
  - Prioritize problems within the patient
- Horizontal resuscitation
  - Spread effort across a number of patients
- Vertical resuscitation
  - Step by step process within patient care

# BEING PREPARED

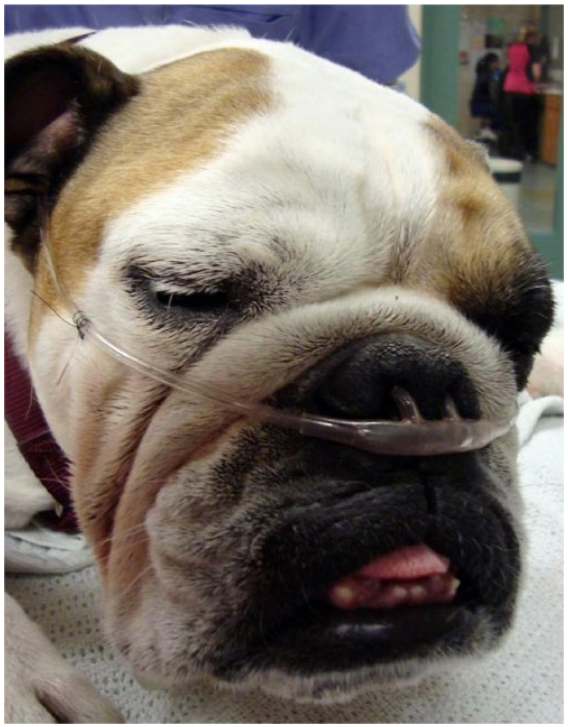
- Adequate staffing
- Crash cart/box
  - Well stocked
  - Essentials
- Deliver $O_2$
- Ready area
- Able to perform routine diagnostics
- Being prepared for the worst case scenario

# INITIAL ASSESSMENT

- Primary survey
  - Airway
  - Breathing
  - Circulation
  - Disability
  - External Assessment
- Concurrent treatment
  - $O_2$
  - Analgesia/sedation
    - Opioids
    - +/- Benzodiazepines

# OXYGEN THERAPY

- Face mask
- Blow-by
- $O_2$ cages
  - High $FiO_2$
  - 40-60%
- Oxygen hood
- Emergency intubation
  - Rapid sequence induction
  - 100% $O_2$
- Emergency tracheostomy



**Comparison of high flow nasal cannula oxygen administration to traditional nasal cannula oxygen therapy in healthy dogs**

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# High-flow nasal canula

**Pros:**

- Comfortable – humidified, warmed air similar to physiologic conditions in naso/oropharynx
- Can deliver precise, set FiO2
- Extremely high flow rates provides low amounts of PEEP
- Leaves mouth free for talking/eating/coughing

**Cons:**

- Not immediately available, sometimes limited supply

## Evaluation of oxygen administration with a high-flow nasal cannula to clinically normal dogs

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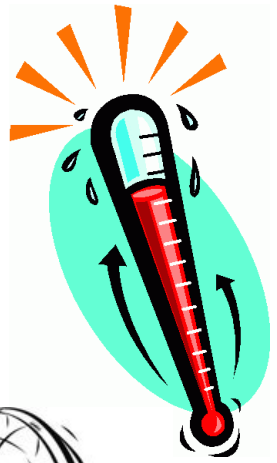
**OBJECTIVE**
To evaluate the safety and efficacy of oxygen administration by use of a high-flow nasal cannula (HFNC) in sedated clinically normal dogs.

**ANIMALS**
6 healthy adult dogs undergoing routine dental prophylaxis.

**PROCEDURES**
Dogs were sedated with butorphanol tartrate and dexmedetomidine. An esophageal balloon catheter was inserted into the esophagus, a double-pronged nasal cannula was inserted into the nares, and a catheter was inserted into the dorsal pedal artery. Dogs were positioned in right lateral

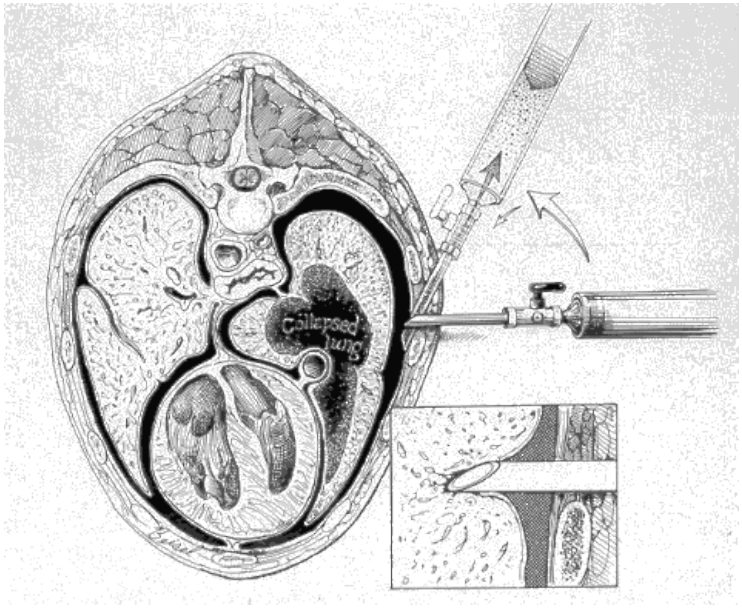
# EXTERNAL COOLING



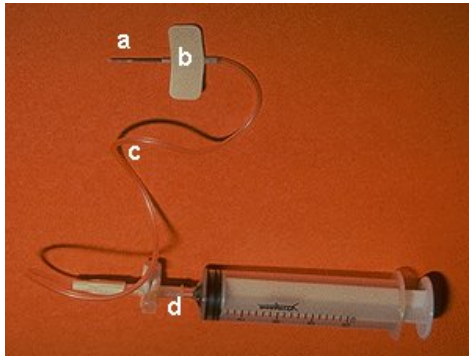
- Hyperthermia
  - Upper airway obstruction
  - Increased work of breathing
  - Inability to thermoregulate
    - Ineffective ability to blow off heat
- Cooling
  - Room temp IVF
  - Cover patient with wet towels
  - Fan
  - Stop when temperature reaches 103F/39C

# THORACOCENTESIS

- Common with pleural space disease





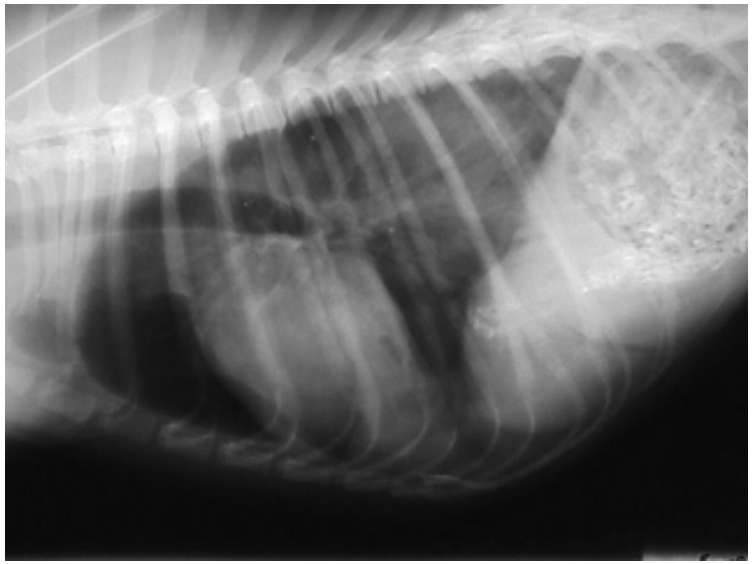


# SIGNALMENT

- Upper airway obstruction
  - Laryngeal paralysis
    - Large breed dogs
  - Brachycephalic syndrome
    - Bulldogs
    - Pug
- Cardiogenic pulmonary edema
  - Small breed dogs
- Lower airway obstruction
  - Asthma
    - Cats

# HISTORY

- HBC?
  - Blunt trauma
    - Contusions
    - Pneumothorax
    - Diaphragmatic hernia
- Cough?
  - Cats?
    - Asthma
  - Dogs?
    - Tracheobronchial disease
    - Pulmonary edema
    - Pulmonary parenchymal disease



# PHYSICAL EXAM

- Distant exam
  - Breathing pattern
  - Noise
  - Abdominal distension
    - Possible underlying heart disease?
    - Possible pulmonary edema

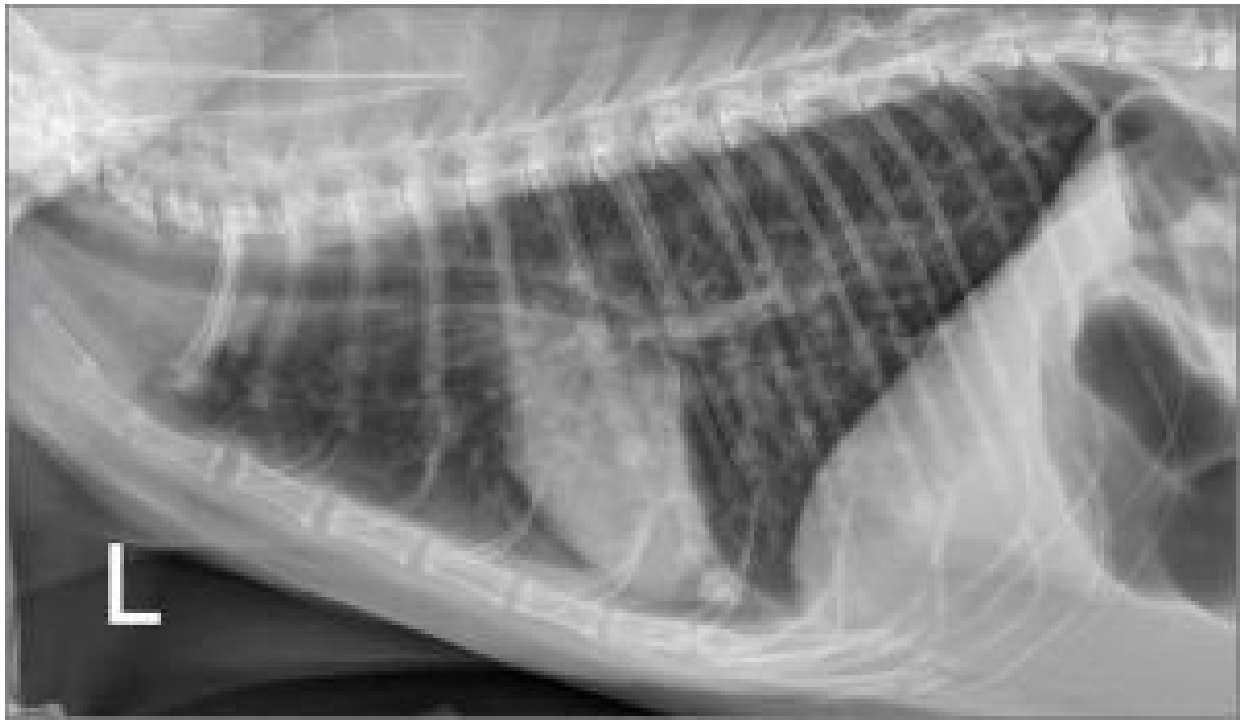
- Lung auscultation
  - Crackles and wheezes
    - Lower airway and parenchymal disease
  - Decreased lung sounds with restrictive pattern
    - Pleural space disease
- Cardiac auscultation
  - Murmurs, gallops, arrhythmias

# Respiratory Pattern Recognition

| Disease category | Examples | Breathing Patterns |
|---|---|---|
| Upper airway | Brachycephalic syndrome<br>Laryngeal paralysis | Inspiratory stridor<br>Ext. audible noise |
| Lower airway | Asthma | Expiratory distress<br>Wheezes |
| Parenchymal disease | Pneumonia<br>Pulmonary edema<br>Pulmonary contusions | Inconsistent; rapid shallow, inspiratory/expiratory patterns |
| Vascular | Pulmonary embolism | Nonspecific |
| Pleural space disease | Pneumothorax<br>Pleural effusion | Inspiratory distress; rapid shallow. Paradoxic motion.<br>Reduced lung sounds |
| Flail chest | | Focal, paradoxic movement |
| Abdominal distension | Ascites<br>Organomegly | Inspiratory distress |

Flail Chest

# Feline bronchiolitis/asthma



# DIAGNOSTIC TESTING

- Limited at first
  - Stabilize
- Brief PE
- Use your respiratory patterns
  - Localize disease
- Prioritize routine diagnostics
  - Blood analysis
  - Imaging
    - Radiographs
    - TFAST
  - Respiratory fluid analysis
    - Pleural space disease
    - TTW
- Airway exam
  - Upper airway
  - Bronchoscopy
- Drug trials
  - Bronchodilators
  - Corticosteroids
  - Diuretic
  - Sedation
    - Dexaterbutalasatrol??

# SEDATION - DOGS

- Butorphanol
  - 0.1-0.4 mg/kg IM/IV; q1-4h PRN
- Acepromazine
  - 0.005-0.05 mg/kg IM/IV; q1-4h PRN
- Dexmetomidine
  - 2-5 mcg/kg IV
- Midazolam
  - 0.1-0.2 mg/kg, IV

- Butorphanol
  - Safe
  - Good sedation; **POOR** analgesia
- Acepromazine
  - Hypotension
  - Long duration
- Dexmetomidine
  - Reversible
  - Bradycardia
  - Hypotension
- Midazolam
  - CV sparring effect
  - Not good solo agent

# SEDATION - CATS

- Methadone + Ace
  - 0.1-0.25 mg/kg, IM, IV (slow)
  - Acepromazine 0.01-0.02 mg/kg
- Hydromorphone + Ace or Hydromorphone + Midazolam
  - Hydro 0.05-0.1 mg/kg IM/IV
  - Midazolam 0.1-0.2 mg/kg IM/IV
- +/- Dexdomitor
  - 2-5 mcg/kg IM/IV

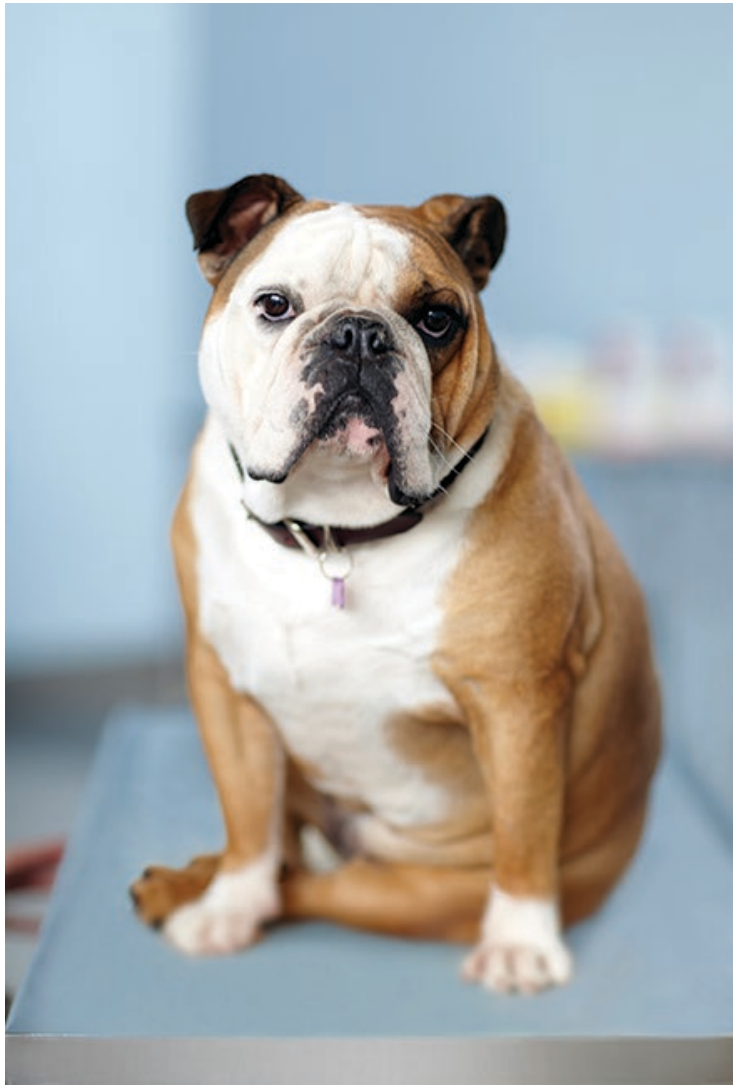
- Methadone/Hydromorphone
  - Pure mu
  - Reversible
  - Relative safety
- Midazolam
  - Safe overall
  - Synergistic
- Dexdomitor
  - Bradycardia
  - Hypotension
  - Reversible

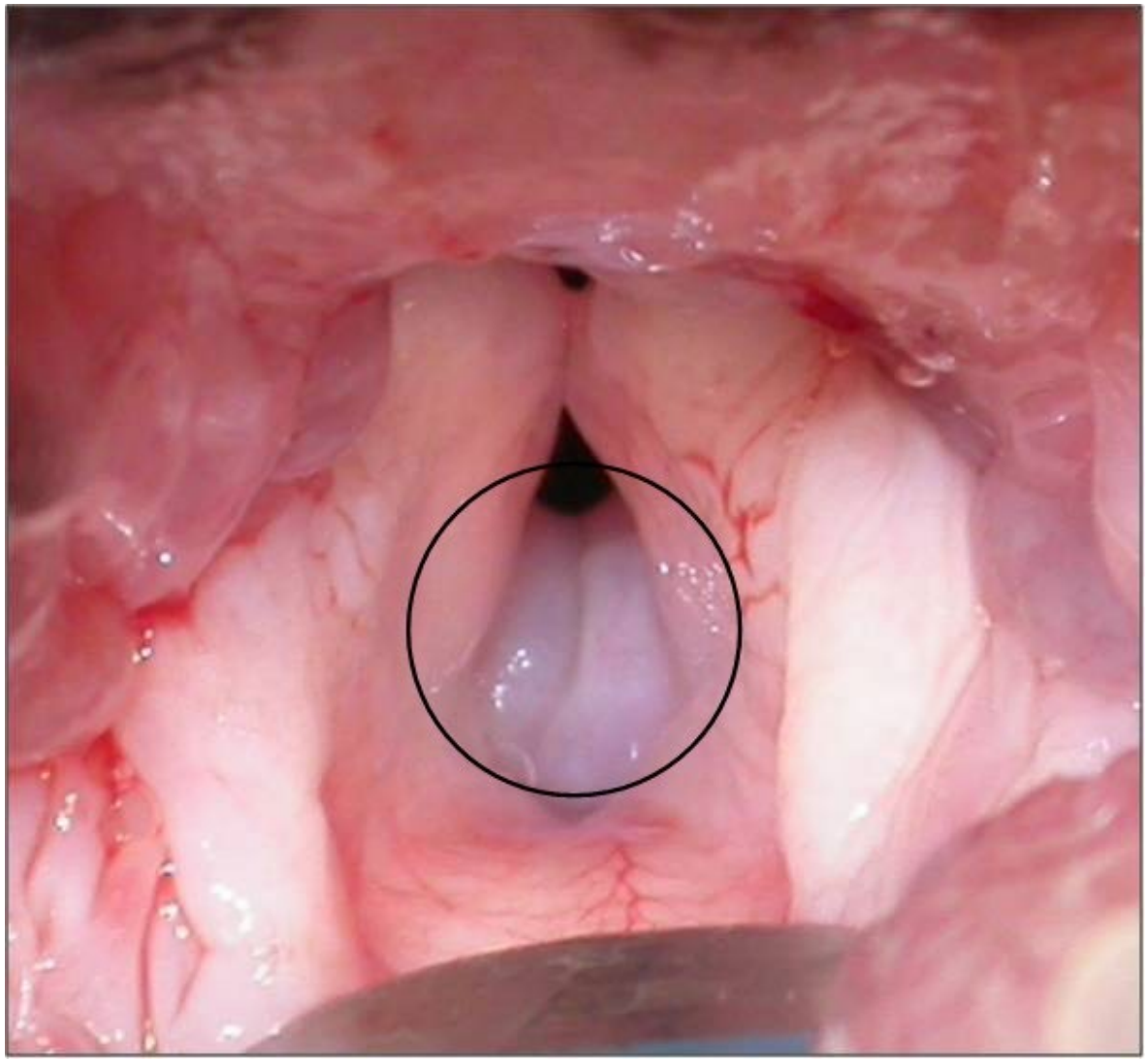


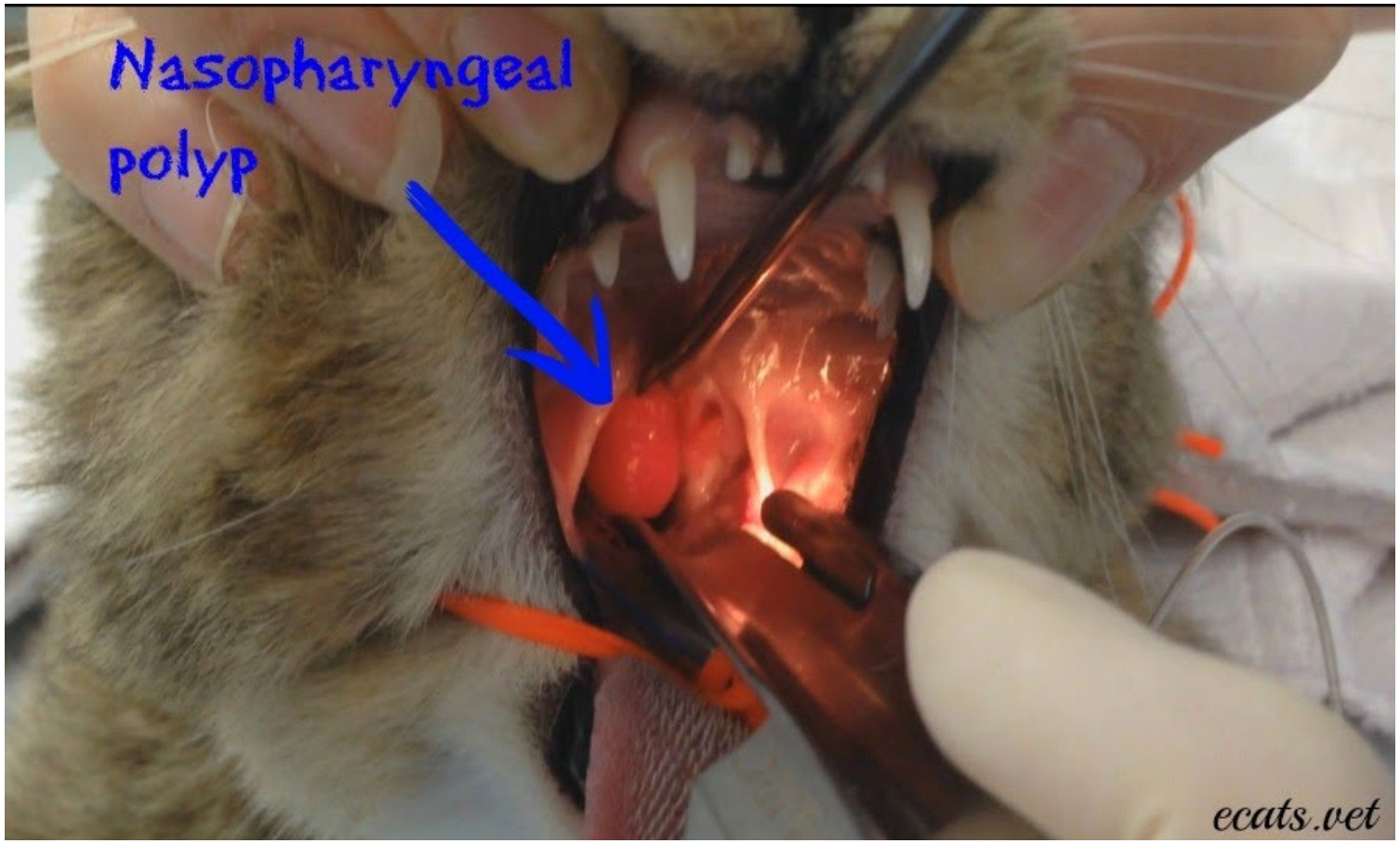
# Upper Airway Obstruction

# ETIOLOGY

- Mechanical/functional obstruction
  - Brachycephalic syndrome
- Nasopharyngeal
  - Polyps, masses and foreign bodies
- Severe head trauma
  - Bone fragments
  - Hemorrhage and swelling
- Laryngeal disease
  - Lar par
  - Laryngeal collapse
  - Mass/tumor
  - Laryngeal inflammation






Nasopharyngeal polyp
ecats.vet

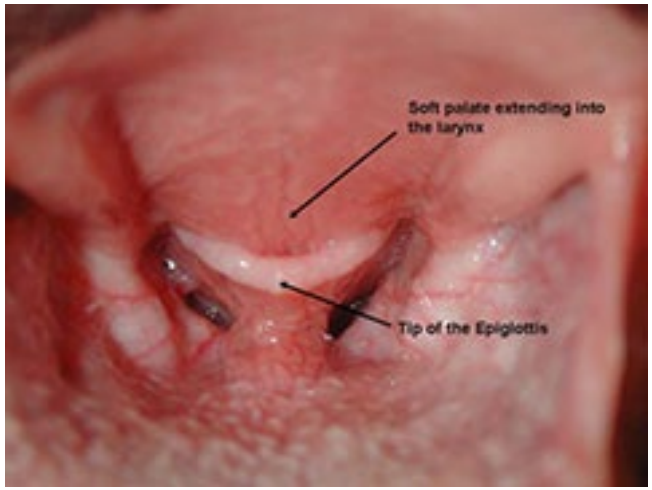
# ETIOLOGY

- Brachycephalic syndrome
  - Primary defects
    - Stenotic nares
    - Elongated soft palate
    - Redundant pharyngeal folds
    - Hypoplastic trachea
      - Bulldogs
  - Secondary defects
    - Laryngeal edema
    - Everted laryngeal saccules
    - Laryngeal collapse
    - GI signs
      - Vomiting, esophagitis, GERD



# CLINICAL SIGNS

- Inspiratory distress
- Audible noise
  - Stridor
  - Sonorous
- Often have a cough



# INITIAL STABILIZATION

- $O_2$
- Sedation
- Cooling
  - If needed
- Corticosteroids
  - Dex SP
    - 0.15 mg/kg IV
    - Maybe repeated
    - Don't go crazy with steroids

# DIAGNOSTIC APPROACH

- Airway exam
  - Preoxygenate
  - Sedated/anesthetic exam
  - Laryngoscopic exam
  - Tracheobronchoscopy
  - Evaluate laryngeal function
    - Sedated exam
    - Avoid over- sedation
    - May need doxapram to stimulate laryngeal motion
    - Abduction on inspiration
      - Increasing aperture of the rima glottis
    - Distinguish paradoxic motion

# DIAGNOSTIC APPROACH

- Cervical and thoracic imaging
  - 3 view chest radiographs
  - +/- CT
- Fluoroscopy
  - Dynamic changes
  - 3rd wave diagnostic

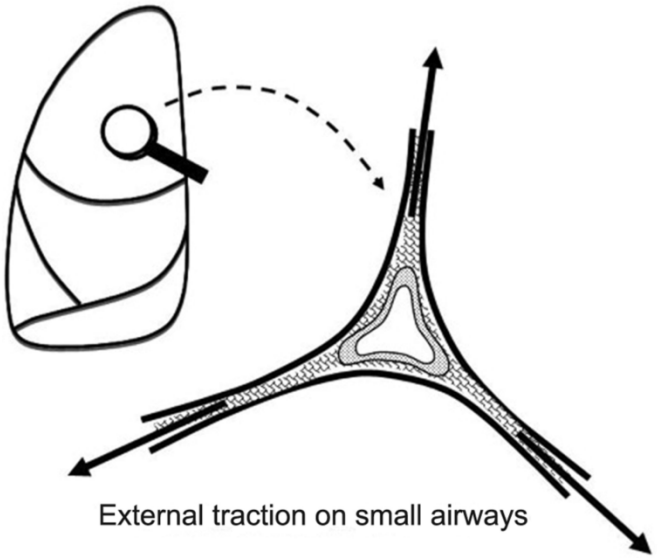
# MANAGEMENT

- Definitive management variable
- Depends on severity and diagnostic findings
- Medical vs surgical management
  - For another time to discuss

# Lower Airway Obstruction

# ETIOLOGY

- Narrowed bronchial lumen
  - Inflammation
  - Edema
  - Hyperemia
  - Bronchospasm
  - Mucus plug
  - Acute anaphylaxis
- Lumen closes early during expiration
  - Expiratory distress most common
- Dynamic traction opens airway during inspiration



# SPECIFIC EXAMPLES

- Asthma - classic
  - Eosinophilic inflammation
  - Reversible bronchoconstriction
  - Remodeling
- Chronic bronchitis
  - In cats
    - Neutrophilic inflammation
    - Eosinophilic/neutrophilic
  - In dogs
    - Bronchomalacia
    - End stage chronic bronchitis

# CLINICAL SIGNS

- Expiratory distress
  - Expiratory grunt
- Audible sounds
  - Wheezing on auscultation
  - Can be externally audible

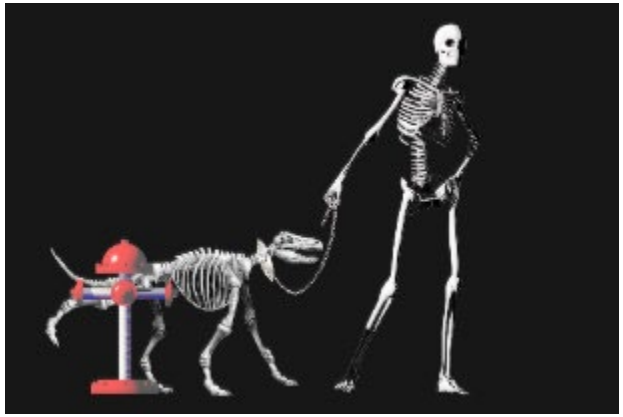
# INITIAL STABILIZATION

- $O_2$
- Bronchodilator trial
  - Inhaled albuterol
    - 1-2 puffs via MDI with a spacer
  - Nebulization
  - Single dose terbutaline
    - 0.01 mg/kg IM/SC
    - Rapid improvement
    - 10-15 min
    - Compare pre and post TX HR
      - Increased rate with activity



# DIAGNOSTIC APPROACH

- Thoracic radiographs
  - Bronchial/bronchointerstitial pattern
  - Air trapping in cats with asthma
  - Flattened diaphragm

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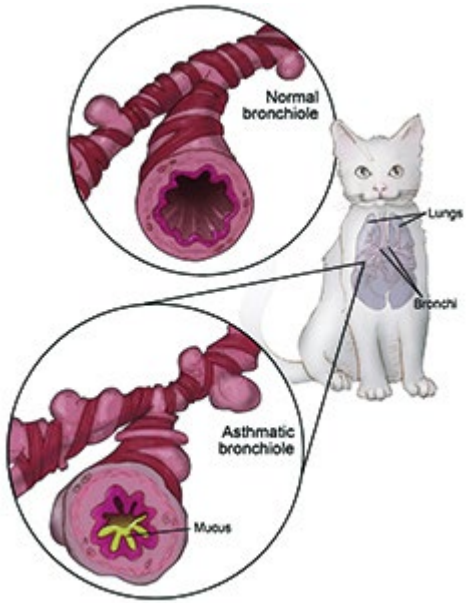
# DIAGNOSTIC APPROACH

- Lower airway cytology
  - BAL, TTW
  - Eosinophilic inflammation > 17%; cats
  - Can be useful to confirm in cases of feline asthma
    - Often times not needed
  - Neutrophilic inflammation
    - Chronic canine bronchitis
- HW testing
  - Ag and Ab in cats
- Echocardiogram

# MANAGEMENT

- Bronchodilators
  - Inhaled
  - Systemic
- Corticosteroids
  - Inhaled
  - Systemic
- Deworming
  - In endemic areas




# Pulmonary Parenchymal Disease

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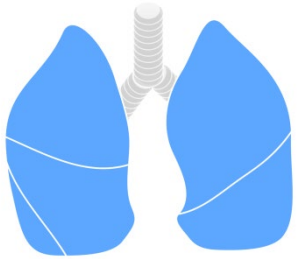
# ETIOLOGY

- Terminal bronchioles
- Interstitium
- Alveoli
- Vasculature



| Classification | Examples |
|---|---|
| Pneumonia | • Infectious<br>• Aspiration |
| Pulmonary Edema | • Cardiogenic<br>• Noncardiogenic |
| Interstitial lung disease | • Idiopathic pulmonary fibrosis<br>• Eosinophilic bronchopneumopathy<br>• HW disease |
| Pulmonary Neoplasia | • Primary<br>• Secondary |
| Traumatic pulmonary injury | • Pulmonary contusions |

# CLINICAL SIGNS

- Loud respiratory sounds on auscultation
  - Harsh lungs
  - Wheezes
  - Crackles
- Presence of a murmur?
- Fever
  - Reported in 12.5 % of dogs and 25% of cats with pneumonia

# INITIAL STABILIZATION

- $O_2$
- Diuretic ?
  - If high index of suspicion of cardiogenic edema
  - Furosemide
    - 2-4 mg/kg IV/IM
- Antibiotics
  - High index of suspicion of bacterial pneumonia
  - ASAP*
  - *After airway sampling if this is planned

# DIAGNOSTIC APPROACH

- Thoracic radiographs
- Echocardiography
  - Especially when the clinical picture isn't clear
- NT-pBNP
  - Peptide associated with atrial stretch

Positive NTproBNP→ likely cardiac related. Needs ECG and echocardiogram

Negative NTproBNP + no auscultable arrhythmia→likely not cardiac related BUT may have intermittent arrhythmia; consider Holter or implantable monitor (cardio consult)

- Airway cytology
  - TTW/ET wash/BAL
- Thoracic CT
- Lung Biopsy
  - Solitary lung masses
- Thoracoscopic surgery

# MANAGEMENT

- Depends on underlying disease
- Judicious fluids
  - In some cases
  - **CONTRAINDICATED IN HEART FAILURE**

# MANAGEMENT

- Cardiogenic edema
  - $O_2$
  - Diuretic (furosemide, toresmide, other)
    - Goal: 5-8% body mass loss over 24 hrs
    - Wt frequently
  - Inodilators (pimobenden)
  - Positive inotropes (dobutamine, pimobenden)
  - $ACE_i$ (enalapril, benazepril)

# MANAGEMENT

- Infectious pneumonia
  - $O_2$
  - Antimicrobials
    - Broad spectrum initial
    - Refined with C&S results
      - BAL/TTW/ET wash/cytology
  - Nebulization/coupage
    - Saline
    - Saline + albuterol (??)

# MANAGEMENT

- Interstitial lung disease
  - Challenging cases
  - May require steroids
- Pulmonary neoplasia
  - Management depends on type
    - Primary
    - Metastatic
  - Surgery
  - Chemotherapy
  - Radiation

# Pulmonary Embolism

# ETIOLOGY

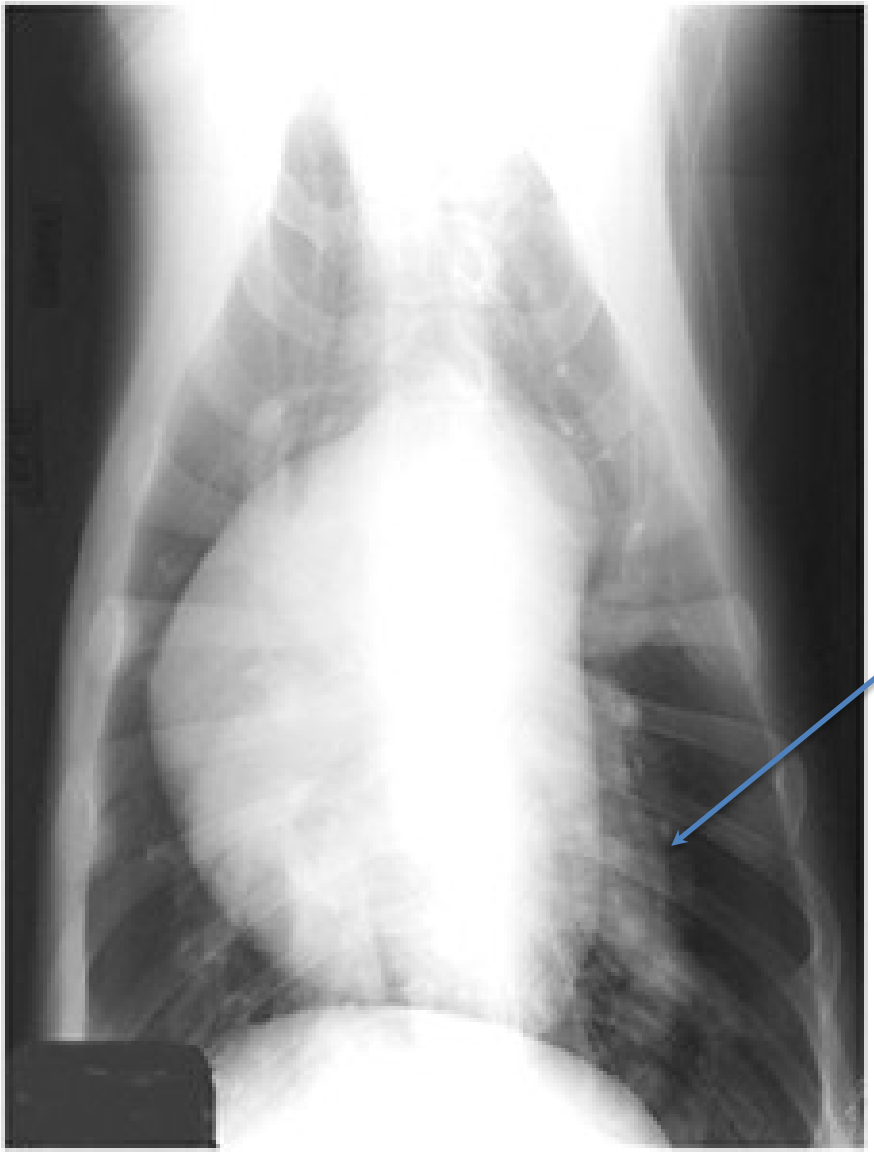
- Causes like any cause of TE
  - Virchow's triad
    - Turbulent blood flow or stasis
    - Endothelial injury
    - Hypercoagulability
- Important to treat aggressively
  - Despite not knowing the underlying cause
  - Prevent further TE events

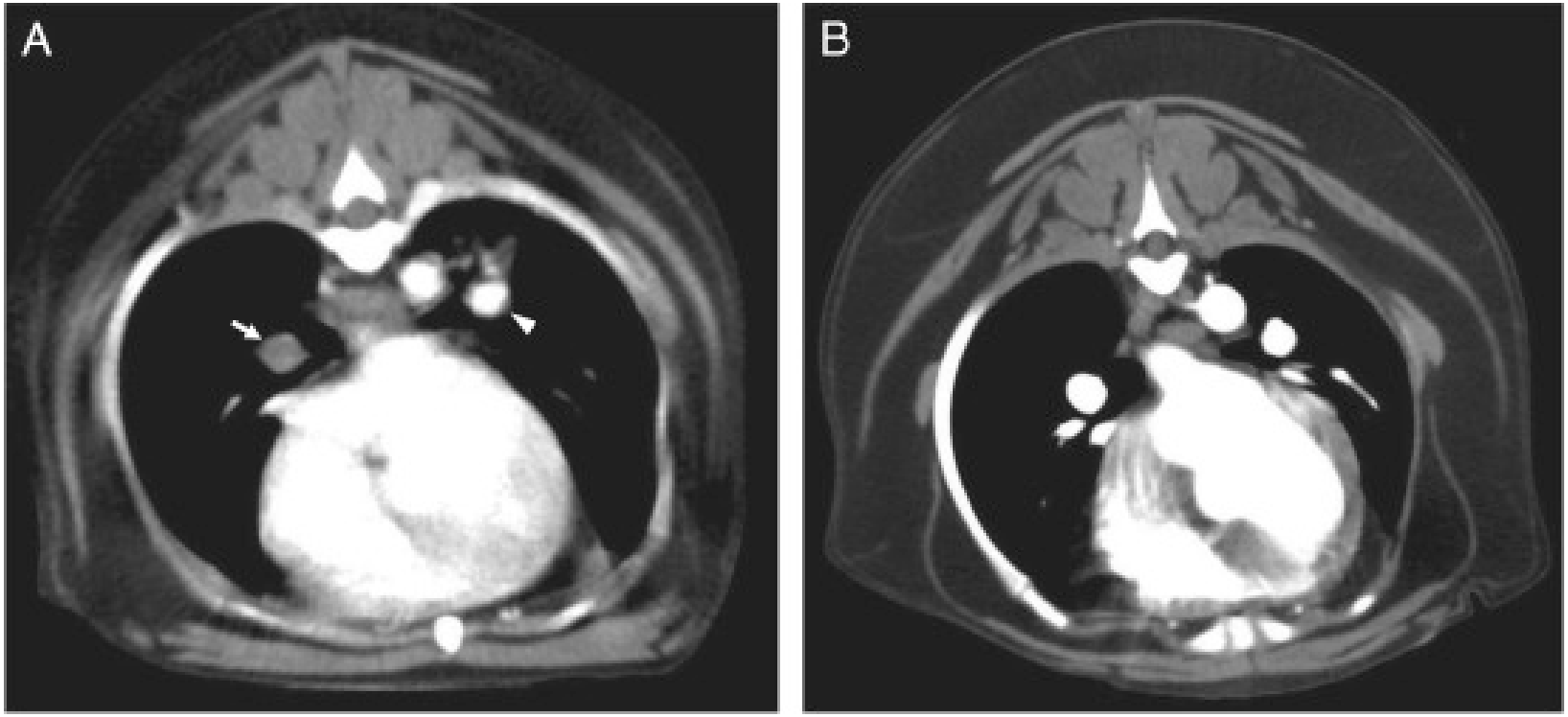
Diseases/conditions that predispose to hypercoagulable state

| Disease | Conditions |
|---|---|
| Cardiac disease | Exogenous corticosteroids |
| DIC | Indwelling IV catheters |
| HW disease | |
| HAC | |
| IMHA | |
| Neoplasia | |
| PLE | |
| Sepsis | |

# CLINICAL SIGNS & DIAGNOSTIC APPROACH

- Thoracic radiographs
  - May be normal
- Respiratory distress out of proportion with radiographic changes
  - Or lack of changes!
  - Focal hypolucency or vessel truncation
  - MPA  dilation or R heart enlargement
    - Pulmonary hypertension
- Echocardiogram useful
- CT angiography
- V/Q scan
  - Less common


PA truncation




CT pulmonary angiography (CTPA) from two dogs with immune-mediated haemolytic anaemia. (A) Positive CTPA study diagnostic for PTE. Intraluminal filling defects can be clearly seen in both the right (arrow) and left (arrowhead) main pulmonary arteries. The filling defect in the left pulmonary artery is only partial at this level. (B) Negative CTPA study which rules out PTE in this patient. There is normal opacification of both left at right pulmonary arteries by contrast at this level. No aortic filling defects were noted in this study

Goggs, Robert & Chan, Daniel & Benigni, Livia & Hirst, C & Kellett-Gregory, Lindsay & Luis Fuentes, Virginia. (2014). Comparison of computed tomography pulmonary angiography and point-of-care tests for pulmonary thromboembolism diagnosis in dogs. The Journal of small animal practice. 55. 10.1111/jsap.12185.

# STABILIZATION & MANAGEMENT

- $O_2$
- Address underlying disease
- Thrombolytic
  - Systemic vs catheter guided
- Anticoagulants
  - Unfractionated heparin
  - LMWH
    - Enoxaparin
    - Dalteparin
- Antiplatelet
  - Clopidogrel (Plavix)

American College of Veterinary Emergency and Critical Care (ACVECC) Consensus on the Rational Use of Antithrombotics in Veterinary Critical Care (CURATIVE) guidelines: Small animal

Conclusions: Overall, systematic evidence evaluations yielded more than 80 recommendations for the treatment of small animals with or at risk of developing thrombosis. Numerous significant knowledge gaps were highlighted by the evidence reviews undertaken, indicating the need for substantial additional research in this field.

Goggs, Robert & Blais, M-C & Brainard, Benjamin & Chan, Daniel & deLaforcade, Armelle & Rozanski, Elizabeth & Sharp, Claire. (2019). American College of Veterinary Emergency and Critical Care (ACVECC) Consensus on the Rational Use of Antithrombotics in Veterinary Critical Care (CURATIVE) guidelines: Small animal. Journal of Veterinary Emergency and Critical Care. 29. 12-36. 10.1111/vec.12801.

# LOW MOLECULAR WEIGHT HEPARIN AND CLOPRIDOGREL

- Ideal antithrombotic therapy unknown
- Ok to combine clopidogrel and LMWH
  - Dalteparin (LMWH)
    - 150 U/kg q12h
  - Clopidogrel
    - 2 mg/kg q24h in dogs
    - 18.75 mg/day in cats
  - Monitor anti-Xa activity
    - Cornell

# STABILIZATION & MANAGEMENT

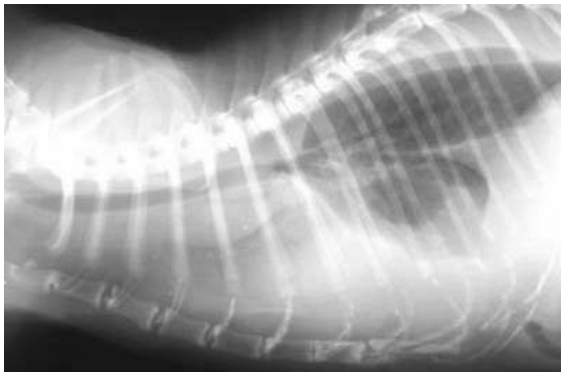
- Thrombolytics
  - tPA
    - Many adverse effects when given systemically
  - IR catheterization and focal tPA
- Pulmonary hypertension
  - Sildenafil
    - Moderate to severe PH
  - Pimobenden
    - Inodilator

# Pleural Space Disease

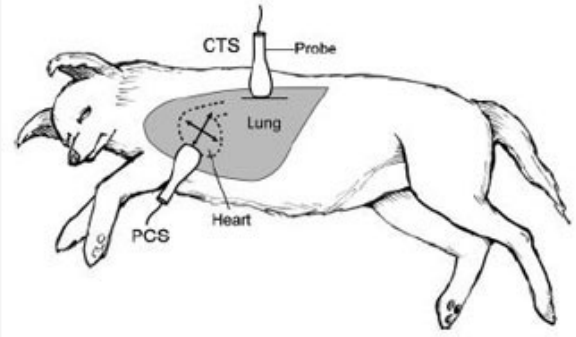
# ETIOLOGY & CLINICAL SIGNS

- Abnormal accumulation of fluid, air, mass or organs
  - Impairs inspiration
- Inspiratory distress
- Rapid, shallow respiration
- Paradoxical breathing pattern
  - Chest falls during inspiration
  - Abdomen expands
- Decreased lung sounds

# DIAGNOSTIC APPROACH

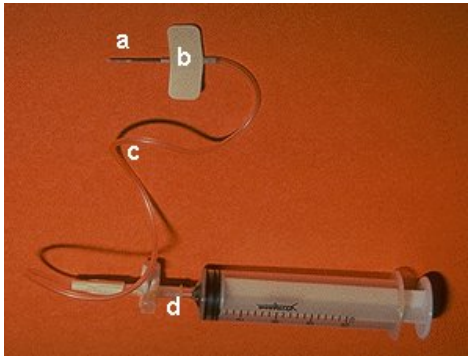


- TFAST
  - Thoracic focuses assessment with sonography in triage (trauma)
  - FASTvet.com
- Thoracic radiographs
- Echocardiogram
- CT
  - Bicav

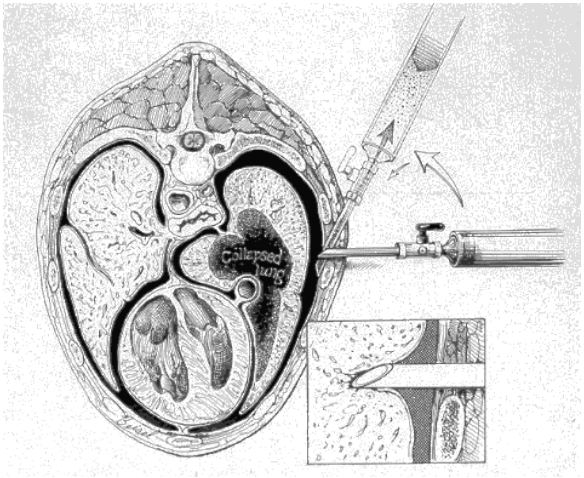



Vistas del TFAST. PCS: punto pericardico, CTS: puntos toracicos

# DIAGNOSTIC APPROACH




- Thoracocentesis
  - Diagnostic and therapeutic
    - If no US, go with thoracocentesis
  - If US available
    - Ideally after TFAST and before XR




# STABILIZATION AND MANAGEMENT

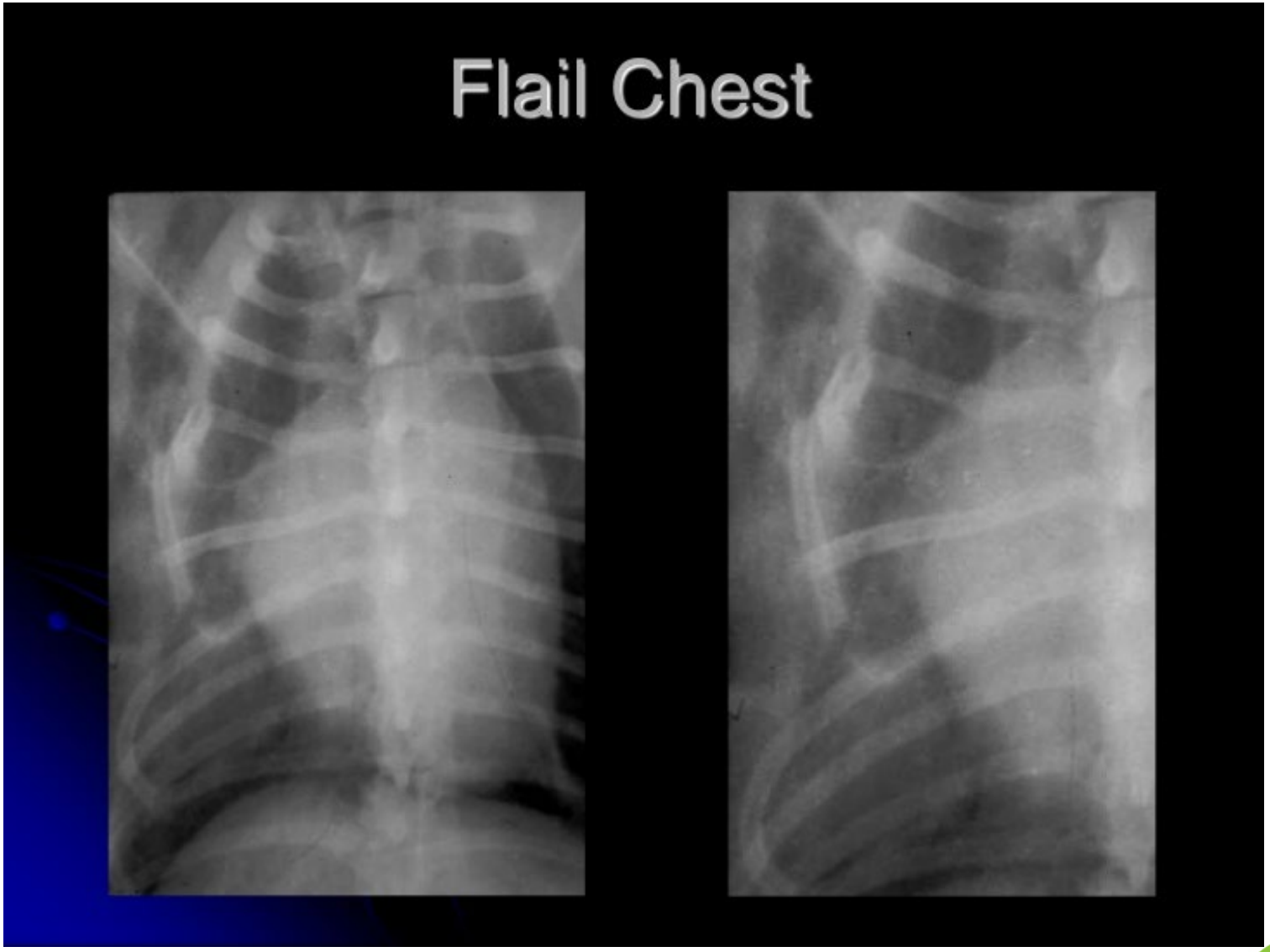
- Thoracocentesis
  - First and foremost
  - Save fluid
    - Cytology
    - C&S
- $O_2$
- Address the underlying cause

# Flail Chest

# ETIOLOGY

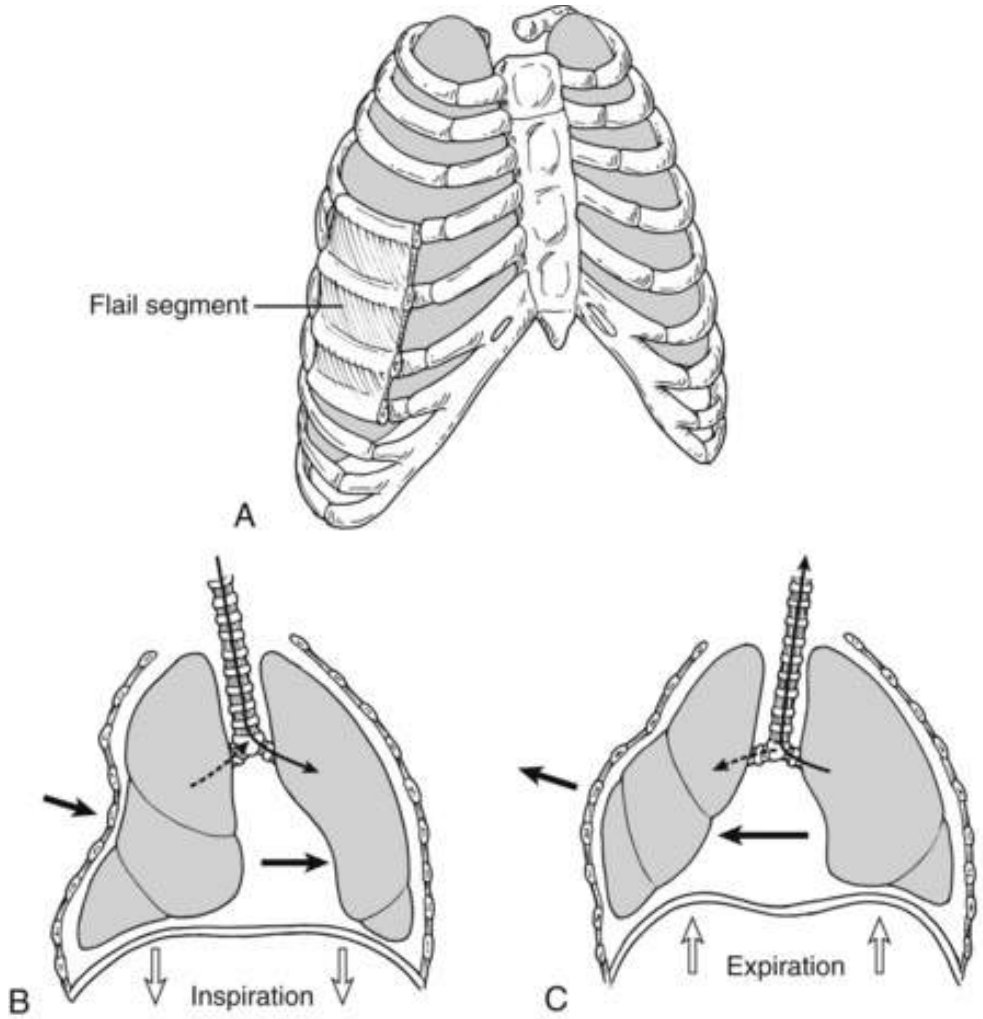
- Destabilization of the chest wall
- Multiple rib effected
- Free floating section of chest
  - 2 consecutive ribs
- Concurrent injuries
  - Pulmonary contusions
  - Pneumothorax
  - Other fractures

# Flail Chest



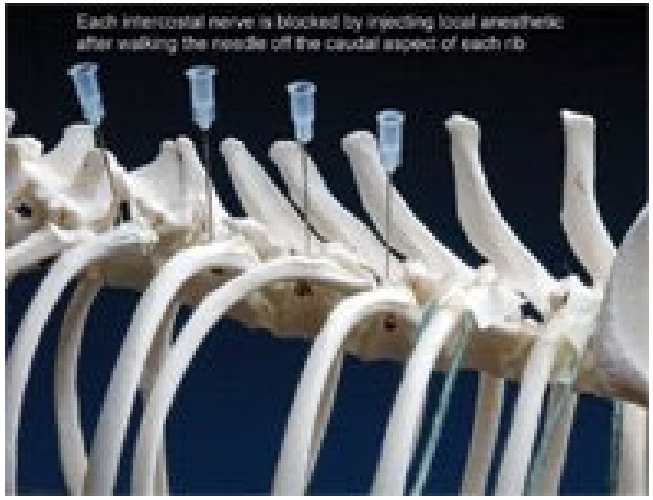
# CLINICAL SIGNS & DIAGNOSTIC APPROACH

- Visually obvious in most cases
  - Paradoxic chest wall motion
- Radiographs to confirm nature and extent
  - Assess pulmonary parenchymal  injury
- Ribs fracture
  - Extremely PAINFUL
    - Pain management a MUST
  - Rapid, shallow respiratory pattern


Flail segment
A
B
Inspiration
C
Expiration

# STABILIZATION & MANAGEMENT

- $O_2$
- IV fluids
  - Careful
  - Pulmonary contusions
- Analgesia
  - Systemic analgesia
    - μ opioids preferred
    - NSAIDS
      - Only once hemodynamically stable
  - Local nerve blocks – lidocaine/Marcaine
    - In cats, reduce the dose (no Marcaine in cats)



# STABILIZATION & MANAGEMENT

- Bandaging
  - Helps to reduce motion
  - Not too tight
- Surgery
  - If penetrating wounds
    - Yes
    - Otherwise
      - May not be of benefit - splint??
  - Use imaging to help guide SX

# SUMMARY

- $O_2$
- Look at the patterns to identify anatomic location
- Systematic approach to diagnostic and therapy
- Minimize stress
- Appropriate pain management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