Code Blue!

Respiratory Distress: triage, diagnostics and treatment options

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OVERVIEW

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

EMERGENCY

TRIAGE NURSE
Being the worst makes you first.

VCA Specialty Animal Hospitals
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

VCA Specialty Animal Hospitals
BEING PREPARED

• Adequate staffing
• Crash cart/box
  – Well stocked
  – Essentials
• Deliver O₂
• 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
• O₂ cages
  – High FiO₂
  – 40-60%
• Oxygen hood
• Emergency intubation
  – Rapid sequence induction
  – 100% O₂
• Emergency tracheostomy
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
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
<table>
<thead>
<tr>
<th>Disease category</th>
<th>Examples</th>
<th>Breathing Patterns</th>
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<tbody>
<tr>
<td>Upper airway</td>
<td>Brachycephalic syndrome</td>
<td>Inspiratory stridor</td>
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<tr>
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<td>Laryngeal paralysis</td>
<td>Ext. audible noise</td>
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<tr>
<td>Lower airway</td>
<td>Asthma</td>
<td>Expiratory distress</td>
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<td>Wheezes</td>
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<tr>
<td>Parenchymal disease</td>
<td>Pneumonia</td>
<td>Inconsistent; rapid shallow, inspiratory/expiratory patterns</td>
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<tr>
<td></td>
<td>Pulmonary edema</td>
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<td></td>
<td>Pulmonary contusions</td>
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<tr>
<td>Vascular</td>
<td>Pulmonary embolism</td>
<td>Nonspecific</td>
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<tr>
<td>Pleural space disease</td>
<td>Pneumothorax</td>
<td>Inspiratory distress; rapid shallow. Paradoxic motion. Reduced lung sounds</td>
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<tr>
<td></td>
<td>Pleural effusion</td>
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<tr>
<td>Flail chest</td>
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<td>Focal, paradoxic movement</td>
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<tr>
<td>Abdominal distension</td>
<td>Ascites</td>
<td>Inspiratory distress</td>
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<td>Organomegly</td>
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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
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
DIAGNOSTIC APPROACH

- Lower airway cytology
  - BAL, TTW
  - Eosinophilic inflammation > 17%; cats
    - 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
ETIOLOGY

- Terminal bronchioles
- Interstitium
- Alveoli
- Vasculature

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>• Infectious&lt;br&gt;• Aspiration</td>
</tr>
<tr>
<td>Pulmonary Edema</td>
<td>• Cardiogenic&lt;br&gt;• Noncardiogenic</td>
</tr>
<tr>
<td>Interstitial lung disease</td>
<td>• Idiopathic pulmonary fibrosis&lt;br&gt;• Eosinophilic bronchopneumopathy&lt;br&gt;• HW disease</td>
</tr>
<tr>
<td>Pulmonary Neoplasia</td>
<td>• Primary&lt;br&gt;• Secondary</td>
</tr>
<tr>
<td>Traumatic pulmonary injury</td>
<td>• Pulmonary contusions</td>
</tr>
</tbody>
</table>
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
• Airway cytology
  – TTW/ET wash/BAL
• Thoracic CT
• Lung Biopsy
  – Solitary lung masses
• Thoracoscopic surgery

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)
MANAGEMENT

• Depends on underlying disease
• Judicious fluids
  – In some cases
  – CONTRAINDIATED 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

<table>
<thead>
<tr>
<th>Disease</th>
<th>Conditions</th>
</tr>
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<tbody>
<tr>
<td>Cardiac disease</td>
<td>Exogenous corticosteroids</td>
</tr>
<tr>
<td>DIC</td>
<td>Indwelling IV catheters</td>
</tr>
<tr>
<td>HW disease</td>
<td></td>
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<tr>
<td>HAC</td>
<td></td>
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<tr>
<td>IMHA</td>
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<tr>
<td>Neoplasia</td>
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<td>PLE</td>
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<tr>
<td>Sepsis</td>
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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
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.

STABILIZATION & MANAGEMENT

- **O₂**
- 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.

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
  – Pimobendan
    • 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
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
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
STABILIZATION & MANAGEMENT

- **O₂**
- **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