APPROACH TO RADIOGRAPHIC INTERPRETATION IN THE CARDIAC PATIENT

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THORACIC RADIOGRAPHS

▸ Utility
  ▸ Assess for cardiomegaly/specific cardiac chamber enlargement
  ▸ Assess for evidence of pulmonary edema (congestive heart failure)
  ▸ Assess for causes of respiratory signs
    ▸ Cough, tachypnea, dyspnea, orthopnea
  ▸ Readily available

INDICATIONS FOR THORACIC RADIOGRAPHS

▸ Coughing
▸ Dyspnea/tachypnea
▸ New heart murmur (assess for cardiomegaly)
▸ Collapse
▸ Exercise intolerance
▸ Geriatric profile
▸ Staging Neoplasia
**RADIOGRAPH ACQUISITION**

- Ideally both laterals and DV or VD view
- DV view may be less stressful in a dyspeptic patient
- DV view better outlines the caudal lobar pulmonary vessels
- VD view shows more lung to evaluate
- Radiographs should be taken at peak inspiration if possible to best evaluate the lung fields
  - Lateral view: caudodorsal aspect of lung will be caudal to T12; heart and diaphragm will be separated
  - DV/VD view: Tips of the lungs will be caudal to T10

**INSPIRATORY VS EXPIRATORY**

[Images of inspiratory and expiratory views]

**INSPIRATORY VS EXPIRATORY**

[Another set of inspiratory and expiratory views]
ASSESSING HEART SIZE – THE VHS

- Canine VHS
  - Normal < 10.5 vertebrae
  - Short chest < 11 vertebrae
  - Long chest < 9.5 vertebrae
  - Useful for following progression of cardiomegaly
  - Normal VHS does not rule out mild cardiomegaly
THORACIC RADIOGRAPHS IN CATS

- Thoracic radiographs may have a lower yield in diagnosing patients with mild-moderate cardiac disease
- As the most common form of cardiac disease is HCM (heart grows initially "inward")
- VD radiograph is more reliable to assess VHS in cats
- Use short axis dimension scaled to vertebrae starting at the cranial border of T4
- Normal VHS in this plane is generally < 3.5 vertebrae

Source: Dr. James Buchanan
GENERAL FELINE GUIDELINES

▸ The heart is more elongated and elliptical in shape than in the dog on the lateral view
▸ The cardiac silhouette occupies about 2-2.5 intercostal spaces on the lateral view
▸ On the lateral view the heart tends to be horizontal - as cats age, hearts tend to horizontalize even more ("lazy heart")
▸ On the VD/DV view, the heart is generally more oval and thinner and the apex usually lies on the midline

LEFT HEART ENLARGEMENT - CATS
THORACIC RADIOGRAPHS IN CATS

- "Valentine" shaped heart
- On VD/DV
- Relates to left atrial/auricular enlargement
- Shifting of the apex from midline

RADIOGRAPHIC CHANGES OF CHF (CANINE)

1. Cardiomegaly
   - Left atrial enlargement
2. Pulmonary venous distension (not always present)
   - Leads to capillary hypertension
3. Interstitial pulmonary edema
   - Peribronchial and interstitial changes
4. Alveolar pulmonary edema (severe)
   - Alveoli become flooded
   - Air bronchograms
APPEARANCE & DISTRIBUTION OF PULMONARY EDEMA (CANINE)

- Interstitial edema most common in mild-moderate cases
- Clouding of the pulmonary vasculature where vessels are obscured by edema fluid
- Peribronchial pattern may also be noted
- Central peri-hilar region progressing outward and caudodorsally
- Sometimes also in the crania-ventral region on lateral
- On the DV/VD view, commonly noted in the right caudal lung lobe in dogs with mitral valve disease
APPEARANCE & DISTRIBUTION OF PULMONARY EDEMA (CATS)

- In contrast to dogs, distribution of cardiogenic pulmonary edema is extremely variable.
- In cats, reported distribution pattern of pulmonary edema:
  - Diffuse/non-uniform in 61%
  - Diffuse/uniform in 17%
  - Multifocal in 17%
- Appearance is also variable:
  - In one study all had interstitial changes with 83% have concurrent alveolar changes and 61% having concurrent bronchial changes.
CATS ARE DIFFERENT

- Pleural effusion is a common manifestation of congestive heart failure in feline patients
- Even with primary left sided cardiac disease
- Not uncommon for cats to have both pleural effusion and pulmonary edema
- Pleural effusion is more common in canine patients with DCM (myocardial failure) and may be noted in some dogs with mitral valve disease when they develop pulmonary hypertension and/or atrial fibrillation
RADIOGRAPHS IN PRIMARY RESPIRATORY DISEASE

- Interstitial pattern
- Peribronchial & bronchial pattern
  - Airway wall thickening
- Right heart enlargement, pulmonary artery enlargement
  - Pulmonary hypertension
- Tracheal collapse
  - Best evaluated with fluoroscopy
  - Redundant tracheal membrane
- Or, radiographs may be “normal” in appearance
PULMONARY HYPERTENSION (PH) - THE GREAT PRETENDER

- Defined as a pulmonary artery pressure (PAP) > 30 mmHg systolic
- PAP influenced by blood flow, pulmonary vasculature resistance and pulmonary venous pressures
- Numerous causes in veterinary medicine
  - Most common: heartworm disease, secondary to left heart disease and secondary to pulmonary disease

PH DIAGNOSIS

- Challenging as signs overlap with mitral valve disease/CHF
  - Similar patient population at risk
- Clinical signs
  - Cough, dyspnea, syncope (exertional), lethargy, exercise intolerance ascites (if right heart failure)
- Exam Findings
  - +/- murmur (right apical), split heart sound, crackles, ascites, jugular venous distension, positive hepatopulmonary reflex test

DIFFERENTIATION MR/CHF FROM PH

<table>
<thead>
<tr>
<th>Pulmonary Hypertension</th>
<th>Mitral Valve Disease with CHF</th>
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<tbody>
<tr>
<td>Murmur may not be audible, right apex</td>
<td>Historic chronic heart murmur (years)</td>
</tr>
<tr>
<td>Murmur more recent</td>
<td>Murmur best heard over the left apex</td>
</tr>
<tr>
<td>Split S2</td>
<td>Systolic click may be present in early stages</td>
</tr>
<tr>
<td>Acrase</td>
<td>Acrase uncommon unless atrial fibrillation or develop concurrent PH secondary to</td>
</tr>
<tr>
<td>Coarse, loud and diffuse crackles</td>
<td>Crackles may be heard, but generally higher, and inspiratory</td>
</tr>
<tr>
<td>Historical chronic cough (months-years)</td>
<td>Cough is more recent</td>
</tr>
<tr>
<td>Jugular venous distension, positive hepatopulmonary reflex test</td>
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JUGULAR VENOUS DISTENSION

PH RADIOGRAPHIC DIAGNOSIS

- Pulmonary artery dilation, tortuosity, abruptly tapered
- Pulmonary infiltrate pattern not typical of CHF
  - May have a bronchial component
- Right heart enlargement
  - Increased sternal contact, loss of cranial waist, reverse D appearance
- Lack of left atrial enlargement
MITRAL VALVE DISEASE

▸ Generally characterized by a prolonged occult phase of disease (years) and thoracic radiographs are useful in following progression over time
  ▸ May also indicate when therapy is indicated (Vetmedin)
  ▸ Thoracic radiographs are useful to assess for causes of coughing in dogs with mitral valve disease
    ▸ CHF, left mainstem bronchus compression, primary airway disease

▸ Evaluate left atrial size (caudal cardiac waist)
▸ Evaluate pulmonary vasculature
▸ Evaluate for pulmonary edema
▸ Generally radiographs are recommended q. 6-12 months in dogs with mitral valve disease to follow disease progression
LEFT MAINSTEM BRONCHUS COMPRESSION

- Likely compounded by concurrent tracheobronchial malacia
- Treatment directed at reducing left atrial pressures, antitussives, bronchodilators (helps prevent ‘downstream’ bronchoconstriction)
**MITRAL VALVE DISEASE & CHF**

- Evaluate for pulmonary venous distension
- Scrutinize the right caudal lung lobe
  - Pulmonary infiltrates not always symmetric in the caudal lung fields
- Not uncommon to see right cranioventral lung lobe involvement
- Cardiomegaly should be present
DILATED CARDIOMYOPATHY

- Acquired myocardial disease characterized by systolic dysfunction
- Generally seen in large and giant breeds
- Taurine deficient cardiomyopathy noted in some Goldens, Cocker Spaniels
- Diagnosed via echocardiography
- Thoracic radiographs can be used to assess overall heart size and evaluate for progression to CHF
- Presence of pleural effusion common in patients with DCM
HYPERTROPHIC CARDIOMYOPATHY

- Diagnosed via echocardiography
- Radiographs are insensitive to detect mild-moderate HCM
- Pleural effusion is common
- DV/VD view in cats is generally more sensitive to detect left atrial enlargement (Valentine shaped heart)
- Pulmonary venous distension is not always present when CHF is present
PERICARDIAL EFFUSION

- Enlarged, globoid cardiac silhouette with loss of the cardiac contours
- Enlarged caudal vena cava may be present
- Pleural effusion, ascites may be present; pulmonary metastasis may be present if effusion due to neoplasia
- Physical exam hallmarks: muffled heart sounds, jugular venous distension, pulsus paradoxus
- Confirmed via echocardiography but suspicion is heightened with exam findings, history and thoracic radiographs
PERICARDIAL EFFUSION??

Young Labrador Retriever, asymptomatic
SUMMARY

- Thoracic radiographs continue to be an important part of the cardiac evaluation
- Gold standard test to diagnose CHF
- Indicated for patients with respiratory signs
- Cats are challenging
- Complementary to echocardiography