Lung Patterns

VMB 960
3/7/2011

Abnormal Lung Pattern Classification
- Alveolar
- Interstitial
- Bronchial
- Vascular (covered with heart lecture)
- Mixed

Normal
- May be the MOST DIFFICULT pattern to diagnose!
- The ability to see vessels, bronchi and some interstitial markings is NORMAL
- Although “technically” not a pattern, determination of ‘normal’ is obviously critical
Normal

- Broad range of normal depending on:
  - Age of the animal
  - Conformation of the animal
  - Phase of respiration
- Be clear if you mean “radiographically normal” or “clinically normal”
- Does a normal lung pattern mean an absence of lung pathology? NO!!
Alveolar Lung Pattern

Flooding of alveoli with ‘blood, pus or water’

Hallmark sign of alveolar lung disease is the **air bronchogram**

Increased soft tissue opacity in alveolar space, gas remains in bronchi
Alveolar Pattern

Radiographic Signs
- Increased soft tissue opacity (can be intense)
- "Air bronchogram"
  - Does NOT have to be present
  - If present → alveolar pattern
- Loss of visualization of the vessels
- Cannot see bronchial walls

Special Circumstances
- Lobar sign
- Atelectasis/collapse

Note change in lesion conspicuity between left and right lateral views
Alveolar Pattern

There are two DIFFERENT mechanisms that can result in an alveolar pattern

- **CONSOLIDATION**
  - Fluid or cells in the alveoli (blood, pus, water)
- **ATELECTASIS**
  - Collapse of the alveoli
- Both result in an increase in soft tissue opacity in the alveolar space

<table>
<thead>
<tr>
<th>CONSOLIDATION</th>
<th>ATELECTASIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid and/or cells in the alveoli</td>
<td>Collapse of the alveoli (loss of air in alveoli)</td>
</tr>
<tr>
<td>No mediastinal shift</td>
<td>Mediastinal shift</td>
</tr>
<tr>
<td>Lung lobe “normal” size</td>
<td>Lung lobe decreased in size</td>
</tr>
<tr>
<td>Not necessarily associated with pleural disease</td>
<td>Often associated with pleural disease</td>
</tr>
<tr>
<td></td>
<td>- Pneumothorax</td>
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<tr>
<td></td>
<td>- Pleural effusion</td>
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Alveolar Lung Pattern

General Causes of Alveolar lung disease

- Atelectasis  eg: recumbency
- Edema  eg: LH failure
- Hemorrhage  eg: coagulopathy
- Inflammatory exudates  eg: pneumonia
- Infiltrate  eg: PIE
Alveolar Lung Pattern

Most common cause of generalized alveolar lung disease is Pulmonary Edema

- Increased Hydrostatic Pressure
- Reduced Oncotic pressure
- Increased Capillary Permeability

Alveolar Lung Pattern

Focal alveolar lung disease

- Multiple causes
- Differential diagnosis prioritization influenced by distribution and intensity of change
- Accurate history important in ranking differentials

Alveolar Lung Pattern

Important ‘distribution patterns’

- Generalized: perm/hydro/onc
- Cranioventral: pneumonia
- Perihilar: hydrostatic
- Caudodorsal: perm/hydro/onc
- Focal: nonspecific
Alveolar Pattern

Pattern Distribution – Aspiration pneumonia
Cranioventral lung lobes
  ❖ Right middle lung lobe most common
    Look for summation sign over the cardiac silhouette on left lateral view!
  ❖ Usually intensity of opacification is most severe with inhalation pneumonia

Alveolar Pattern

Pattern Distribution – Pulmonary Edema
  ❖ Cardiogenic
    – Perihilar
    – Can become generalized
  ❖ Non-cardiogenic (or neurogenic)
    – Caudodorsal lung fields
    – Can become generalized
      • Caudodorsal lung fields generally most affected
  ❖ Remember that distribution can change as disease progresses or resolves.
Intersticial Patterns

Unstructured  Structured

Patient factors
• Ageing changes
• Inflammatory processes
• Infiltrative processes
• Vasogenic factors

Technical factors
• Under exposure
• Expiratory radiograph
• Obesity

Usually generalized / diffuse

Unstructured Interstitial Pattern

Technical factors
• Important that thoracic radiographs are made on PEAK INSPIRATION
   – Expiratory films may artifactually cause or enhance an unstructured interstitial pattern
• Other factors that may cause an APPARENT unstructured interstitial pattern
   – Respiratory motion
   – Obesity
   – Underexposure
Expiration Inspiration Inspiration vs Expiration
Same dog, same views. Note difference in degree of soft tissue lung opacity!

Unstructured Interstitial Pattern
Hazy/amorphous increase in soft tissue opacity
- The result of:
  - Fluid and/or cells in the interstitial space
  - Fibrosis in the interstitial space
    - Chronic inflammation
    - Normal ageing change

Diffuse Unstructured Interstitial Pattern - LSA Normal
Interstitial Lung Disease (LSA)

Unstructured Interstitial Pattern
Peribronchial enhancement
The ability to see the bronchi “better” because of an increase in opacity of the interstitium
– adventitial border of bronchus is ill-defined and bronchus appears thick

Note some bronchi have thick “fuzzy” border, this suggests surrounding interstitial disease.
Unstructured Interstitial Pattern

Overlap of Patterns

- A severe unstructured interstitial pattern may mimic a mild alveolar pattern
  - Sometimes cannot distinguish between the two patterns
  - If in doubt identify the pattern as alveolar
    - being most severe

Interstitial Patterns

Structured

Non-cavitary
- Extrathoracic
- Fake out
- Tumor 1 or 2
- Granuloma

Cavitary
- Abscess / cyst
- Necrotic tumor
- Parasitic

-Focal or generalized-

Interstitial Patterns

Structured - Non-cavitary

- Focal or generalized
  - Nodular
    - Metastatic lung disease
    - Primary lung mass
    - Pulmonary osseous metaplasia
    - Granuloma fungal, eosinophilic, FB
    - Abscess
    - Fluid filled bulla
  - Miliary
    - Fungal – Blastomycosis
Intense Miliary
– with coalescence

Structured / Nodular Interstitial

Radiographic appearance
- Circumscribed lesions of various opacity, size and number in the interstitial space of the lung
- May be single or multiple
- May be CAVITARY or NON-CAVITARY
  - CAVITARY = CONTAINS GAS OPACITY
  - NON-CAVITARY = NO GAS OPACITY
- Can have cavitary and non-cavitary lesions in the same patient

Where are the nodules?
- The nodules are located in the interstitial space
- The interstitial space contains the:
  - Vessels
  - Bronchi
  - Nerves
  - Lymphatics
- The nodules are between or invade the structures of the interstitial space
Structured / Nodular Interstitial

End-on Vessel
- Located near other vessels
- Same size or smaller than associated longitudinal vessels
- Tend to follow a pattern
- May be near a bronchus
- Typically well-defined smooth margins
- May have a "tail"
- More opaque than expected for size

Pulmonary Nodule
- Does not have to be near vessels
- Can be any size
- Random in location
- Does not have to be near a bronchus
- Margins may be smooth or irregular
- No "tail"

Structured / Nodular Interstitial

Pulmonary Nodule or Something on Skin?
- Ectoparasites (ticks), skin masses, nipples etc. can mimic a pulmonary nodule
- Structures on the surface often more opaque than expected due to air/soft tissue interface
- Place radiopaque marker on "lesion" to determine location

Extrathoracic "Nodule"

Note large nipples on lateral view

"Perfect" alignment of "nodules" of the same size should be a clue that these structures may not be pulmonary.
Cavitary Structured Interstitial Pulmonary Pattern
Hematocoele (Blood-filled bulla)

Horizontal beam radiograph – note the fluid lines in the pulmonary masses.

Structured Interstitial – cavitary

Bronchial Pattern
Radiographic appearance
- Increased visualization of the bronchi
- Typically most difficult pattern for students to recognize
- Must look for normally visualized pulmonary structures
  - Bronchi
  - Vessels
Bronchial Pattern

Radiographic Findings
- Increase in size of bronchi
- **Apparent** increase in number of bronchi
  - Due to increase in size of bronchi
- Loss of taper
  -Bronchial walls become parallel
- Bronchial wall thickening
  - Can be difficult to distinguish from peribronchial enhancement

Special Circumstances
- Bronchial mineralization
  - Can be a normal aging change
  - If only finding, probably do NOT have a bronchial pattern

Bronchial Pattern

Radiographic Findings
- Increase in size is RELATIVE
- Look in the periphery of the lung fields
  - Look for end on bronchi
  - Should have a lucent center
- Look VERY closely!
- Although identified as large, the bronchi are still very small!
  - Especially in CATS!!!
Bronchial Bronchial Bronchiectasis

note airway collapse on expiration
Lung Patterns
Case Discussions

3/8/2011

Things we will cover
- Lung Model using Adobe Photoshop
- Case Discussions

Case 1
- 1 year old German Shepherd 70722
- Female spayed
- Febrile and dyspnea
Case 1 Findings

- There is soft tissue opacification with air bronchograms in the right middle lung lobe, caudal part of the right cranial lung lobe and to a lesser degree of the caudal portion of the left cranial lung lobe.

- The heart and pulmonary vessels are small consistent with hypovolemia possibly due to dehydration.

What are the most likely differentials for this pattern?

Case 2

- 12 year old Labrador Retriever  67933
- Male castrate
- Chronic progressive paraparesis
Case 2 Findings

- There is a moderate diffuse bronchial (bronchointerstitial) lung pattern with thickening and mineralization of bronchial walls.
- Pleural fissure lines are present – probably a manifestation of pleural fibrosis.
- Changes are consistent with chronic inflammatory airway disease.

Bronchial - another example

Case 3

- 2 year old Chinese Crested 51167
- Male
- Rescued from a garage fire. Severe dyspnea
Case 3 Findings

- Extensive air bronchograms are present throughout the lung parenchyma, indicating a diffuse, intense alveolar pattern.
- In light of the history, pulmonary edema secondary to smoke inhalation is the most likely diagnosis.

Case 4

- 10 year old Golden Retriever 86906
- Male
- Osteosarcoma – distal femur
Case 4 Findings

- Multiple variably-sized soft tissue pulmonary nodules are present throughout the lungs.
- Cardiovascular structures appear within normal limits.
- This pattern is typical of metastatic lung disease.

What are other differentials for a nodular interstitial pattern?

Case 5

- 5 year old Cocker Spaniel 66558
- Constipation and tachypnea
- Constipation thought due to pelvic canal mass

What are the radiographic findings?
What are the most likely differentials?
Case 5 Findings

- A soft tissue opacity is superimposed over the carina with apparent ventral deviation of the principal bronchi. This finding is consistent with tracheobronchial lymphomegaly.
- There is a fine reticular interstitial pattern, most pronounced in the caudodorsal lung fields.
- An infiltrative disease as with Lymphoma or a fungal infection should be considered.

Case 6

- 10 year old German Shepherd 84623
- Male castrate
- Intermittent cough
Case 6 Findings

- An alveolar pattern is present in the caudal part of the left cranial lung lobe.
- A patchy alveolar pattern is also present in the right cranial lung lobe.
- The cardiovascular structures are within normal limits.
- Dorsal deviation of the trachea is likely a manifestation of head position.

What are the most likely differentials for this pattern?