Endobronchial lesions: Detection, Causes and Management

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Objectives

- Review the etiology of endobronchial lesions
- Recognise the ancillary CT findings which may help in diagnosis
- Suggest appropriate follow up or work up for endobronchial lesions
Assessment of the airways

- Bronchoscopy
  - Established role in investigation of bronchopulmonary disease
  - Extraluminal extent of disease not evaluated

- MDCT
  - Multiplanar reconstructions
    - Routinely obtained
    - Excellent for visualized airways oriented oblique to the axial plane
  - More advanced reconstructions (e.g., curved planar reconstruction or 3D reconstructions)
    - Not proven to increase detection of abnormalities
    - Can improve diagnostic confidence
    - Can provide more anatomically familiar information to the respirologist* (e.g. for planning of intervention)

*Radiographics. 2012 Sep-Oct;32(5):201-32*
Assessment of bronchial lesions

- Small endobronchial lesions can be subtle
- Be aware of the small endobronchial lesion or "isolated mucus plug"

Scholten et al. of NELSON trial. Eur Radiology 2015
22 missed lung cancers on screening visible in retrospect:
- 5/22 small endobronchial lesions
- 3/22 mediastinal or hilar LNs
- 5/22 thickening of a bulla wall
- 2/11 observation error ie parenchymal nodules

- Ancillary findings can help in detection of endobronchial lesions
  - Ancillary findings:
    - Finger-in-glove sign
    - Obstructive atelectasis
    - Obstructive consolidation
    - Post-obstructive bronchiectasis
    - Air-trapping
    - Double artery sign
CASE: Allergic bronchopulmonary aspergillosis (ABPA) in an asthmatic 66-year-old. Impaction of large airways is manifested as branching tubular opacities.

CASE: Patient with an endobronchial carcinoid causing obstruction. A ball-valve mechanism is resulting in air trapping.

CASE: 83-year-old with a carcinoid tumor obstructing the right main bronchus with secondary post-obstructive pneumonia.

CASE: 25-year-old with a carcinoid tumor causing distal bronchiectasis and mucus plug.

CASE: 69-year-old with an endobronchial carcinoid causing distal bronchiectasis and mucus plug.

CASE: 42-year-old. Top image shows a normal open bronchus. Lower image shows mucus filling the same bronchus, giving an impression of double artery.

Finger-in-glove sign
Post-obstructive atelectasis
Post-obstructive consolidation
Post-obstructive bronchiectasis
Air trapping
Double artery sign

Ancillary findings:
- Finger-in-glove sign
- Post-obstructive atelectasis
- Post-obstructive consolidation
- Post-obstructive bronchiectasis
- Air trapping
- Double artery sign

Ancillary findings:
- Double artery sign
- Post-obstructive bronchiectasis
- Post-obstructive consolidation
- Post-obstructive atelectasis
- Finger-in-glove sign

CASE: Allergic bronchopulmonary aspergillosis (ABPA) in an asthmatic 66-year-old. Impaction of large airways is manifested as branching tubular opacities.

CASE: 83-year-old. CT scan shows the biopsy proven squamous cell carcinoma (SCC) in the left lower lobe bronchus with distal atelectasis.

CASE: 25-year-old. The patient with a carcinoid tumor obstructing the right main bronchus with secondary post-obstructive pneumonia.

CASE: 69-year-old. The patient with an endobronchial carcinoid causing distal bronchiectasis and mucus plug.

CASE: 42-year-old. Top image shows a normal open bronchus. Lower image shows mucus filling the same bronchus, giving an impression of double artery.
The double artery sign is seen when a portion of the bronchial tree is filled with mucous or soft tissue.

When this occurs, the associated pulmonary artery will be accompanied by an apparently identical tubular structure.
Because the PULMONARY ARTERIES travel with the BRONCHI, the impacted bronchus will parallel its accompanying artery.

**Ancillary findings**

Double artery sign

Two parallel opaque tubular structures coursing through the lung together is not a normal CT finding.

If IV contrast has been administered, changing the windowing can help distinguish the enhancing artery from the impacted bronchus.
Endobronchial lesions

- Focal lesion
- Diffuse process

Endobronchial material

- Tumor
  - Benign
  - Malignant

Endobronchial material

- Mucus
  - Common with COPD
- Blood
- Pus or infected material
  - e.g.: Broncholith, Foreign body
- Bronchiectasis
- ABPA

COPD, Asthma, Bronchiectasis, ABPA
Benign endobronchial material

**Mucus plug**

- Again, be aware of the *isolated mucus plug*, as it could be an early sign of a malignancy.
- However, *multiple* mucus plugs are reassuring and usually seen in the setting of:
  - Asthma
  - COPD
  - Bronchiectasis

CASE: 72♂. The initial CT scan shows an incidental small endobronchial round lesion (arrow). A mucus plug was presumed, as it resolved on the CT scan done 2 months later (left image).
Benign endobronchial material

Examples of bronchiectasis and typical distribution

- Cystic fibrosis
- Tuberculosis (usually asymmetric)
- ABPA
- William Campbell
- MAC
- Primary ciliary dyskinesia
- Chronic aspiration
- Hypogammaglobulinemia

Distribution of bronchiectasis:
- Upper lung predominance
- Central lung predominance
- Diffuse
- Mid lung predominance (lingula, RML)
- Lower lung predominance
- Bronchiolitis obliterans

CT scan shows bronchiectasis with mucus plugs and finger-in-glove sign (arrow).
Benign endobronchial material

**ABPA**

Typically present as **bilateral** and **central** bronchiectasis with mucus plugs

Multiple **dense mucous** plugs more specific for ABPA but not sensitive

- Hyperdense = higher than skeletal muscles density

CASE: 66♂ with asthma complicated by ABPA. Hyperdense mucus impaction (arrow) is seen in the right upper lobe with associated lobar collapse.

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**Bronchial atresia**

Results from congenital interruption of the origin of a segmental bronchus

LUL>RUL, M>F

Most detected **incidentally** at chest XR

20% have **recurrent infection**

Associated with air trapping of the involved segment

CASE: 46♀. CT images show a tubular lesion (arrow) consistent with mucus impaction of a bronchus with distal air-trapping.
Benign endobronchial material

Endobronchial blood

CASE: 67♀ with idiopathic pulmonary hemorrhage. CT scan (left) shows blood in the right main bronchus. Resolution on CT scan done 25 days later (right).

Broncholith

Usually caused by:
• Extrusion of a calcified adjacent lymph node in bronchus (tuberculosis, histoplasmosis)
• In situ calcification of foreign material

Foreign body

Peak in second year of life and during 6th decade

Predisposing factors:
• Intubation
• Neurologic deficit
• Facial trauma
• Dental procedure
Benign tumor

- Endobronchial lesions
  - Focal lesion
  - Diffuse process
    - Endobronchial material
    - Tumor
      - Benign
      - Malignant

Endobronchial hamartoma
Endobronchial lipoma
Squamous cell papilloma
Plumonary pleomorphic adenoma

As part of laryngotracheal papillomatosis
Rare salivary-type tumor of the large airways
Benign endobronchial tumor

Hamartoma

- Most common benign lung tumor
- ~10% are endobronchial

CT findings:
- Macroscopic fat (< -40 HU)
  - 60% of hamartomas
  - Essential for diagnosis
- Calcification (>200 HU)
  - ~20% of hamartomas
  - Can be popcorn like (cartilaginous)

CASE: Proven small left main bronchus hamartoma. Tiny amount of macroscopic fat visualized (arrow).

Courtesy Dr Judith Babar, Cambridge University Hospital, UK.
Malignant tumor

Carcinoid
Bronchogenic cancer
Metastasis
Adenoid cystic carcinoma
Mucoepidermoid carcinoma

Salivary gland tumors
- Usually originate in trachea, can extend into the main bronchi
- Rare, most commonly originates in lobar or segmental bronchi
CASE: 42 with an endobronchial carcinoid tumor. The patient presented with chronic cough and hemoptysis for 6 months.
Bronchogenic cancer

- Strongly associated with cigarette smoking

- Central lung cancer types are most often
  - Squamous cell carcinoma (SCC)
  - Small cell carcinoma

- Radiologic features
  - SCC:
    - Frequently has an intraluminal growth
    - Often cause obstructive atelectasis
    - Sometimes cavitate
  - Small cell cancer:
    - The primary in the airway can be imperceptible
    - Often present with large hilar and nodal involvement

CASE: 83♀ with a squamous cell carcinoma. CT images show the intraluminal growth of the tumor with post-obstructive atelectasis.
Malignant endobronchial tumor

Metastasis

- Uncommon
- Usually by direct extension:
  - Lung, esophageal, thyroid cancer
- Hematogenous metastasis to the bronchi seen with:
  - Breast cancer
  - Kidney cancer
  - Colorectal cancer
  - Melanoma
  - Uterine cancer

CASE: 71 year-old woman with endobronchial metastasis from a breast carcinoma.

CASE: 70 year-old man with left main bronchus metastasis from a RCC.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Most frequently involved segments</th>
<th>Characteristics/comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granulomatosis with polyangiitis (Wegener)</td>
<td>Subglottic, involvement of central bronchi in 30%</td>
<td>Stenosis and wall thickening, erosion of cartilage and calcifications possible</td>
</tr>
<tr>
<td></td>
<td>Larynx, upper trachea, and with progression to distal trachea and bronchi</td>
<td>Calcification and wall thickening, sparing of posterior membrane</td>
</tr>
<tr>
<td></td>
<td>Lower two thirds of trachea and main bronchi</td>
<td>Multiple submucosal calcified cartilaginous/bony nodules, sparing of posterior membrane</td>
</tr>
<tr>
<td>Fungal tracheobronchitis</td>
<td>Tracheobronchial</td>
<td>Usually aspergillosis in immunocompromised patients</td>
</tr>
<tr>
<td>Inflammatory bowel disease/Behcet Syndrome</td>
<td>Tracheobronchial</td>
<td>Rare causes of ulcerative tracheitis and tracheobronchitis</td>
</tr>
</tbody>
</table>
Airway amyloidosis is seen in association with systemic amyloidosis or as an isolated manifestation.

- Diffuse involvement of the tracheobronchial tree is usual.
- Less common form is a focal lesion.
- Calcifications are common.

CASE: 64-year-old male with biopsy-proven airway amyloidosis.

CT scan images show wall thickening (green arrow) with calcifications (white arrow) of the central left sided airways. There is also severe stenosis (green arrow) of the left lower and upper lobe bronchi. Partial atelectasis (blue arrows) of both upper lobes is also present.
Stenosis of large airways common at bronchoscopy in sarcoidosis

Rarely symptomatic

Caused by:
- Accumulation of granulomas in bronchial wall
- Extrinsic compression by nodes
- Distortion secondary to fibrotic parenchyma disease

CASE: 65гранич with history of sarcoidosis.
CT scan shows thickening (blue arrow) of the wall and stenosis of the left main bronchus with calcification of adjacent nodes (green arrow).
# Diffuse bronchial wall thickening

**Ganulomatosis with polyangiitis** (Wegener)

Necrotizing granulomatous vasculitis

- **CASE: 64♂**.

CT scan shows abnormal intrabronchial soft tissue (blue arrow) with thickening and stenosis of the right main bronchus. There is complete occlusion of the right main bronchus proximally (green arrow).

**Tracheobronchopathia osteochondroplastica**

- **CASE: 75♀**.

CT scan shows multiple tiny nodules arising from the anterior and lateral wall of the trachea. The posterior membranous portion of the trachea is spared. Although not well appreciated in this case, calcification of the nodules is common.

**Relapsing polychondritis**

Recurrent inflammation of the cartilaginous structures of the nose, ear, joints, larynx, trachea, and bronchi

- **CASE: 47♂**.

CT scan shows calcification and wall thickening of the trachea and bronchi that spares the posterior membranous trachea.
Conclusion

Be aware of the "isolated mucus plug"

Do follow-up when needed and have a low threshold for bronchoscopy

Example of a tiny endobronchial lesion, suspected to be a mucus plug, that became a cancer 2 years later.

Small endobronchial lesions can be subtle and easily missed, especially during a busy day.

Recognize the ancillary findings which may help in diagnosis:

- Double artery sign
- Post-obstructive atelectasis
- Post-obstructive consolidation
- Post-obstructive bronchiectasis
- Air trapping
- Finger-in-glove sign
Conclusion

Endobronchial lesions

Focal lesion

Endobronchial material

Tumor

Benign

Malignant

Diffuse process

Mucus
Broncholith
Foreign body
Blood

Hamartoma
Lipoma
Papilloma
Pleomorphic adenoma

Carcinoid tumor
Bronchogenic tumor
Metastasis
Adenoid cystic carcin.
Mucoepidermoid carcin.

Wegener granulomatosis
Amyloidosis
Sarcoidosis
Infection (tuberculosis, aspergillosis)
Relapsing polychondritis
Tracheobronchopathia osteoplastica
References

- Boiselle PM, Reynolds KF, Ernst A. *Multiplanar and three-dimensional imaging of the central airways with multidetector CT.* AJR Am J Roentgenol. 2002;179:301–308


