Imaging of Nonneoplastic Abnormalities of the Large Airways

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Learning Objectives

- To review the normal anatomy of the tracheobronchial tree on X-ray and CT.
- To review the imaging features of various nonneoplastic diseases affecting the large airways.

Outcomes

- To be familiar with the imaging features and differential diagnoses of nonneoplastic abnormalities affecting the large airways.
The normal anatomy

- The trachea has two sections.
  - The cervical portion: superior to the thoracic inlet
  - The intrathoracic portion: extends from the thoracic inlet to the bifurcation (carina)
The normal anatomy

- The trachea consists of 18 to 22 C-shaped structures made of hyaline cartilage.
  - C-shaped bands of hyaline cartilage support the anterior and lateral tracheal walls.
  - The posterior tracheal wall is supported by a thin band of smooth muscle.
Hyaline cartilage

- Calcification of cartilage is most common in older patients, particularly women.
The trachea, the carina, the both main bronchi and the secondary lobar bronchi are usually seen as the region of lucency on X-ray.
The right paratracheal stripe

- Thin stripe is usually visible between the tracheal air column and the adjacent right lung on the X-ray.
- A right paratracheal stripe is seen in up to 95% of normal individuals; above the azygos vein, it is 2 to 4 mm thick.
Widening of the right paratracheal stripe

A 70-year-old man with small lung cancer. CT shows enlargement of paratracheal lymph node.
- An endobronchial location was the most common type of overlooked lung cancer at CT.

- Abnormalities of the large airways are often overlooked not only on X-ray but also on CT.

*It is necessary to check the tracheobronchial tree on X-ray and CT.*
Using a spiral CT technique and a slice thickness of 5 mm or less, all segmental bronchi should be visible.
Nonneoplastic abnormalities affecting the large airways

Normal variants
- Tracheal bronchus
- Accessory cardiac bronchus

Chronic inflammatory and infiltrative diseases
- Tracheobronchomalacia
- Amyloidosis
- Sarcoidosis
- Relapsing polychondritis
- Granulomatosis with polyangiitis (GPA)
- Tracheobronchomegaly
- Tracheobronchopathia osteochondroplastica
- Broncholithiasis

Infection
- Viral
- Bacterial
  - Endobronchial tuberculosis
- Fungal
  - Allergic bronchopulmonary aspergillosis (ABPA)

Others
- Postintubation stenosis
- Traumatic injury
- Foreign body
Key Points of Imaging Diagnosis

✓ Focal or Diffuse

✓ Narrowing or Widening

✓ With tracheal wall thickening or Without
Infection
- Amyloidosis
- Sarcoidosis
- Relapsing polychondritis
- GPA
- Tracheobronchopathia osteochondroplastica

Mucus
- Extrinsic compression
- Postintubation stenosis
- ABPA

Infection
- Amyloidosis
- Sarcoidosis
- Relapsing polychondritis
- GPA
- Tracheobronchopathia osteochondroplastica

Without wall thickening
- “Saber-sheath” trachea
- Tracheobronchomalacia

Widening
- Tracheobronchomegaly
Tracheal bronchus

✓ 0.1-2%
✓ It is a broad term that includes bronchial anomalies arising from the trachea or a main bronchus that are directed toward an upper lobe.

CT images and 3D-CT image show a tracheal bronchus (red arrow) arising from the right main bronchus. As in this case, the bronchus supplies the apical segment of the right upper lobe (B1).
Accessory cardiac bronchus

- 0.08%
- It is a supernumerary bronchus arising from the inner wall of the bronchus intermedius or, less commonly, the right main bronchus. This bronchus is typically blind ending.

MinIP image and CT images show a supernumerary bronchus arising from the medial aspect of the bronchus intermedius (red arrow).
Paratracheal air cyst

- small air collections in the right paratracheal area at the level of the thoracic inlet
- generally asymptomatic and detected incidentally (8.1%)

Sometimes communicated with the trachea.
CT images and 3D-CT image show a diverticulum arising from the anterior segmental bronchus (B3) of the right upper lobe. (red arrow).
“Saber-sheath” trachea

- A common acquired morphologic abnormality, occurring frequently in men with COPD.

  - Only the intrathoracic trachea is involved.
  - The extrathoracic trachea is not affected.
  - Calcification of tracheal cartilage is frequently seen.

- A sagittal-to-coronal diameter ratio that exceeds 2:1
Relapsing polychondritis

- A rare autoimmune disorder causing recurrent inflammation and subsequent destruction of cartilage in the ear, joints, airways, and nose.

- CT image (soft-tissue window) shows smooth thickening and subtle increased attenuation of tracheal wall (red arrow).

- Note that posterior membranous portion of trachea (blue arrow) is not affected.

- The bronchoscopic images show diffuse airway narrowing from mucosal edema and erythema.
Relapsing polychondritis

- FDG-PET maximum intensity projection image reveals strong uptake at the trachea and bronchus.
- Fused PET/CT image shows FDG accumulation in the tracheal wall (red arrow). Posterior membranous portion of trachea (blue arrow) is not affected.

*FDG PET–CT has several advantages for diagnosing relapsing polychondritis.*
Granulomatosis with polyangiitis (GPA)

Tracheobronchial involvement occurs in about 15% to 25% of cases

- Focal or diffuse
- Smooth or nodular circumferential thickening of the tracheobronchial wall that leads to stenosis
- Irregular calcifications of the tracheal cartilage rings
- Subglottic stenosis
Amyloidosis

- The deposition of abnormal proteinaceous material (amyloid) in extracellular tissues
- Multifocal or diffuse, submucosal in location
- Concentric, smooth, or nodular thickening of the tracheal wall
- Calcification (red arrow)

Amyloidosis also involves the posterior membrane.
Allergic bronchopulmonary aspergillosis

- A result of hypersensitivity to aspergillus and is considered an eosinophilic lung disease
- History of asthma

CT images in lung and in mediastinal windows demonstrate bronchiectasis and high attenuation mucus (red arrow).

Mucous plugs appear high-density
Bronchial tuberculosis

- tuberculous infection of the tracheobronchial tree
  - both active and fibrotic: central airways narrowing
  - active disease: irregular and thick-walled of airways
  - fibrotic disease: generally smooth narrowing of airways

CT images show the parenchymal lesions distal to the right lower lobe bronchial stenosis: segmental collapse, collapse with multiple low density areas and ill-defined small nodular densities.
Broncholithiasis

- Calcified or ossified material is present within the bronchial lumen.
- Calcified lymph nodes erode into an adjacent bronchus.
- Broncholithiasis is considered as a late complication of granulomatous lymphadenitis caused by Mycobacterium tuberculosis or fungi such as Histoplasma capsulatum.
Broncholithiasis

CT images show an old tuberculous lymph node eroding into the intermediate bronchus 4-6 years ago. Later, CT images show a calcified nodule within the bronchus intermedius (red arrow).
Mucus

- In daily practice, the most common intraluminal mass seen is mucus.

- It is distinguished from a polyp to identify air bubbles in this pseudolesion and the moving from the location to another.
Postintubation stenosis

- A complication of either endotracheal intubation or placement of the tracheostomy tube
  - High cuff pressure causes ischemic necrosis of the adjacent mucosa and lead to scarring and stenosis.
  - Extrathoracic trachea (at level of the inflated cuff)

CT and 3D-CT images show focal tracheal narrowing.
Posttraumatic injury

- caused by blunt and penetrating trauma, or iatrogenic, appearing after intubation or tracheotomy

- Subcutaneous emphysema, pneumomediastinum and pneumothorax on X-ray

- CT can show the site of airway injury as a focal defect or deformity or as the circumferential absence of the airway wall.
Foreign body

- The most common endobronchial “mass” encountered in children, but can be also seen in adults.

- CT can show and localize both opaque and nonopaque foreign bodies.

- Secondary findings: atelectasis, air-trapping
Take Home Points

- It is necessary to check the central airways whenever they are imaged on X-ray and CT.

- Key points of imaging diagnosis
  - Focal or diffuse
  - Narrowing or widening
  - With tracheal wall thickening or without

- It should be also noted the parenchymal lesions distal to the bronchial stenosis or obstruction such as segmental collapse.


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