The normal chest

Pikom, MD

Advisor: Apichaya, MD; Radiologist
Chest

• Central airways
• Pulmonary hila
• Mediastinum
• The pleura
The Trachea

• From the inferior aspect of the cricoid cartilage (C6) to the carina (T5)
• Length 10-12 cm
• Usually round or oval in shape (horseshoe-shaped, triangular, or like an inverted pear in some normal patients)
Normal trachea

- Mediastinal fat surround Tracheal wall (arrow) (1 to 2 mm soft-tissue stripe)
- The tracheal wall appears thin

Normal calcification of tracheal cartilage

• Discontinuous calcification of the tracheal wall
• Thin tracheal wall
Tracheal diameter

• Normal men
  • Coronal plane averages 19.5 mm (13-25 mm)
  • Sagittal plane 13-27 mm

• Normal women (slightly smaller)
  • Coronal plane averages 17.5 mm (10-21 mm)
  • Sagittal plane 10-23 mm

• Sagittal > coronal seen in saber-sheath trachea (x1.5)
Tracheal diameter

- Forced expiration
  - AP diameter decreases by 30% to 40%
  - Transverse diameter decreases by 10% to 20%

- Significant collapse $\rightarrow$ >50% (tracheomalacia)
Normal expiratory CT

- A: On inspiration, rounded appearance
- B: During a dynamic forced expiratory scan

Anatomy of bronchial segments

Chest

- Central airways
- **Pulmonary hila**
- Mediastinum
- The pleura
Pulmonary hila (frontal radiograph)

- Hilar shadows silhouettes with hilar pulmonary arteries
- Left pulmonary artery higher than the right
- Left hilum higher than the right (97% of cases)
Right Hilum

• Truncus anterior - supplying most of the upper lobe
• Anterior segment bronchus of the RUL
  • Visible in 80% of patients
  • 4- to 5-mm ring shadow in the lateral aspect of the hilum

• Right interlobar pulmonary artery -> exceeds 15 mm in women and 16 mm in men
  • Pulmonary hypertension
Normal right hilum (Plain radiograph)
Normal left hilum

Pulmonary vasculature
Pulmonary vasculature

A = Apical segmental bronchus
B = Posterior segmental bronchus
C = Anterior segmental bronchus
D = Bronchus intermedius
E = Truncus anterior
F = Carina
G = Right main pulmonary artery
H = Left main pulmonary artery
I = Right inferior pulmonary artery
J = Right superior pulmonary vein
K = Right middle lobe bronchus
L = Right lower lobe bronchus
M = Right inferior pulmonary vein
N = Left Atrium
O = Left superior pulmonary vein
P = Apicoposterior segmental bronchus
Q = Left upper lobe bronchus
R = Lingular bronchus
S = Left inferior pulmonary artery
T = Left inferior pulmonary vein

From: https://www.med-ed.virginia.edu/courses/rad/cxr/anatomy6chest.html
Normal right hilar (Lateral chest radiograph)
Normal right hilar (Lateral chest radiograph)
Normal left hilar (Lateral chest radiograph)

Left upper lobe bronchus to posterior aspect of the vessel -> Exceeds 18 mm -> pulmonary hypertension

Normal left hilar (Lateral chest radiograph)

Chest

• Central airways
• Pulmonary hila
• **Mediastinum**
• The pleura
Mediastinum

- Located between the two lungs
- Posterior to the sternum
- Anterior to the vertebral column
- Extending from the thoracic inlet to the diaphragm
CT ANATOMY

- (a) The supraaortic or superior mediastinum
- (b) The region of the aortic arch and aortopulmonary window (APW)
- (c) The pulmonary arteries, subcarinal space, and azygoesophageal recess
- (d) The heart and paracardiac mediastinum
Trachea, tracheal carina, and main bronchi

- Larynx
- Thyroid cartilage
- Cricoid cartilage
- Cartilaginous ring
- Carina
- Left primary bronchus
- Right primary bronchus
- Upper lobe bronchus
- Middle lobe bronchus
- Lower lobe bronchus

From: http://webs.ashlandctc.org/mflath/KEYRESPIRATORYOBJECTIVES_files/image010.jpg
Aortic arch

- Ascending, transverse or arch (proximal, distal, ischmus), and descending segment
Main Pulmonary Artery

- Divides into right and left pulmonary arteries posterior to the ascending aorta and anterior to the main bronchi

Right subclavian artery (RSCA), right carotid artery (RCA), left carotid artery (LCA), and left subclavian artery (LSCA)
Supraaortic (Superior) mediastinum

- Trachea -> centrally located
- Esophagus -> posterior to trachea
- Brachiocephalic veins -> most anterior and lateral vessels visible
- Innominate, subclavian, and carotid arteries lie posterior to veins and adjacent to the anterior and lateral walls of the trachea
Supraaortic mediastinum

Aortic arch and aortopulmonary Window

• Contains the undivided mediastinal great vessels
• The aorta and superior vena cava, and also several important mediastinal spaces and lymph node groups
Aortic arch and aortopulmonary Window

• The average diameter of aorta
  • Proximal ascending aorta averages 3.6 cm (range, 2.4 to 4.7 cm)
  • Ascending aorta just below the arch 3.5 cm (range, 2.2 to 4.6 cm)
  • Proximal descending aorta 2.6 cm (range, 1.6 to 3.7 cm)
  • Mid-descending aorta 2.5 cm (range, 1.6 to 3.7 cm)
  • Distal descending aorta 2.4 cm (range, 1.4 to 3.3 cm)
Aortic arch level
Aortopulmonary window level

Normal superior pericardial recess
Pulmonary Arteries, Subcarinal Space, and Azygoesophageal Recess

• Near level of carina -> main pulmonary artery divides into its right and left branches

• A mean pulmonary artery diameter (measured at its widest point within 3 cm of its bifurcation) of 29 mm

• Left pulmonary artery higher than right
Pulmonary Arteries, Subcarinal Space, and Azygoesophageal Recess

• On the left side, the hemiazygos vein parallels the descending aorta

• Subcarinal space nodes - larger than normal nodes in other parts of the mediastinum and up to 1.5 cm in short-axis diameter
Level of the pulmonary arteries, subcarinal space, and azygoesophageal recess
Heart and paracardiac mediastinum

- Prevascular mediastinum becomes thin or obliterated by the heart contacting the anterior chest wall
- Little soft tissue is visible anterior and lateral to the cardiac chambers
- Azygoesophageal recess remains visible to the level of the diaphragm
Level of the heart and paracardiac mediastinum
Plain radiographic anatomy

• Trachea, tracheal carina, and main bronchi
• Aortic arch
• Main pulmonary artery
• Azygos vein
• Heart and its chambers
Trachea, tracheal carina, and main bronchi

- Trachea -> inferior aspect of cricoid cartilage to tracheal carina (Length ~10-12 cm)
- Tracheal carina -> visible at the bifurcation of the trachea into right and left main bronchi
- Carinal angle -> about 35 to 90 degrees
- Right main bronchus more vertical than the left
Mediastinum

Lines, stripes, and spaces

• To assessment of specific mediastinal structures and compartments
Cardiophrenic angles

• Location: Junction of the anterior hemidiaphragms with the right and left heart borders

• Significance: Convexity or mass may be seen in the presence of
  • (1) Large mediastinal fat pad
  • (2) Lipoma
  • (3) Pericardial cyst
  • (4) Enlarged epicardiac lymph nodes
  • (5) Thymic neoplasm or other anterior mediastinal mass
  • (6) Morgagni hernia
Cardiophrenic angles

A: CPA = costophrenic angles (junction of the anterior hemidiaphragms with the right and left heart borders)

B: Arrows = contact of the lung with the fat filled anterior mediastinum

C: Arrows = concave costophrenic angles
Right paratracheal stripe

- **Location:** Linear region of contact between the right lung and the right tracheal wall, below the thoracic inlet and above the azygos arch
- **Appearance:** A line or stripe, up to 4-mm thick in normal individuals
- **Significance:** Thickening (i.e., more than 4 mm)
  - (1) Tracheal wall abnormalities such as tumor or inflammatory disease
  - (2) Pleural thickening or effusion adjacent to the trachea
  - (3) Enlargement of pretracheal lymph nodes
  - (4) Mediastinal infiltration (e.g., hemorrhage, infection, neoplasm)
Right paratracheal stripe

- T = trachea
- RPS = right paratracheal stripe; Few millimeters thick; From the level of the thoracic inlet to the azygos arch

Vascular pedicle

• Location: Transverse width of the upper mediastinum
• Measured from point cross of SVC and right main bronchus vertical line and point of left subclavian artery arises from aortic arch -> variable can up to 58 mm in normal
• Significance: may be due to
  • (1) Dilatation of the great vessels
  • (2) LN enlargement in the pretracheal space
  • (3) Mediastinal mass
  • (4) Mediastinal infiltration (blood, infection, tumor)
  • (5) Paramediastinal pleural abnormality
Vascular pedicle

- The vascular pedicle (arrows) is measured from the superior vena cava (SVC) to left subclavian artery (LSA) arises from the aortic arch.

Azygoesophageal recess

- **Location**: retrocardiac mediastinum; outlined by RLL; from azygos arch to diaphragm
- **Appearance**: begins at azygos arch - ending at diaphragm in shallow reverse-C or reverse-S contour
- **Convexity may be** -> prominent normal esophagus or azygos vein and common in patients with a narrow mediastinum and in children
Azygoesophageal recess

• Significance: Convexity of the superior aspect
  • (1) Subcarinal lymph node enlargement
  • (2) Subcarinal bronchogenic cyst
  • (3) Left atrial dilatation
  • (4) Dilatation of the azygos vein
  • (5) Esophageal mass or dilatation

• Convexity of the inferior aspect
  • (1) Esophageal mass or dilatation
  • (2) Hiatal hernia
Azygoesophageal recess

• C-E: arrows = azygoesophageal recess, begins at azygos arch (az) and ends at the diaphragm
• F: Coronal reformation shows the azygoesophageal recess (arrows), with a typical contour; A = aorta

Left paraaortic interface

- Location: line between descending aorta and medial left lung
- Straight, concave, or convex interface below the aortic arch, parallel to the left paravertebral stripe
- Significance:
  - Increased convexity - tortuosity of the aorta or diffuse dilatation (e.g., aneurysm or dissection)
  - Focal convexity - aneurysm, LN enlargement, or paraaortic mediastinal mass
Left paraaortic interface

• Paraaortic interface -> line contact between the descending aorta and medial left lung
• Straight, concave, or convex
• Seen below the aortic arch and parallel but lateral to the left paravertebral stripe

• B: Lung outlines the left lateral wall (arrow) of the aorta (A)
• C: Coronal reformation shows left paraaortic interface (arrows), wavy contour because of pulsations; A = descending aorta

RETROSTERNAL CLEAR SPACE

• Appearance:
  • An area of lucency anterior to the heart and great vessels; the anterior margins of the heart great vessels may or may not be clearly seen

• Significance:
  • Increase in depth and lucency with emphysema
  • Decrease in depth with right ventricular or main pulmonary artery dilatation
  • Decrease in lucency in anterior mediastinal mass
Retrosternal clear space (anterior clear space)
Chest

• Central airways
• Pulmonary hila
• Mediastinum
• The pleura
The pleura

• Interlobar fissures
  • Invaginations of the visceral pleura
  • Separate or partially separate the lobes of the lung
  • To localization and diagnosis pleural and parenchymal abnormalities
The fissures (on chest radiographs)

• Major fissures
  • Not normally visible
  • Originate posteriorly above the level of the aortic arch, ~5\(^{th}\) thoracic vertebra
  • 75% - left major fissure is cephalad than right
  • Terminate at anterior diaphragmatic pleural surface

• Minor fissure
  • Visible in 50% to 80% of cases
  • Appearing as horizontal line
  • Generally near 4\(^{th}\) anterior rib
The fissures (on chest radiographs)
The fissures on CT

- A: Upper thorax, the major fissures angle posterolateraly from the mediastinum and anterolateraly in lower thorax
- B: Appearance of the minor fissure on CT related in lateral chest radiograph

Major fissures

- HRCT
- Large arrows = normal-appearing major fissures laterally
- Small arrows = medially, incomplete fissures
The Minor (Horizontal) Fissure
Accessory Fissures

- Separate a lung segment or a part of a lobe from the remainder of a lobe
- As many as 50% of lungs show an accessory fissure
- Less often visible radiographically
Azygos fissure

• Present in 1 in 200 subjects
• At apical or posterior segments of the right upper lobe
• Azygos fissure and azygos lobe -> formed when the azygos vein invaginates the right upper lobe during gestation
• A left "azygos“ fissure, associated with the left superior intercostal vein -> rarely seen
Azygos fissure and azygos lobe

- A: Small arrows = curvilinear of azygos fissure; adjacent to right mediastinum, convex laterally
- Large arrow = azygos arch (visible within the right upper lobe and has a teardrop appearance)
- Black arrow = azygos arch is not visible in its normal location
- B: Arrows = typical curved appearance of the azygos fissure

Azygos fissure and azygos lobe

• C: At a lower level, small arrows = azygos arch
  • Curved line
  • Extends from right brachiocephalic vein
  • Anteriorly to right posterolateral aspect of the T4 or T5 vertebral body

• D: Arrows = Thickening of the azygos fissure due to right pleural effusion in a different patient

Inferior accessory fissure

• Separates medial basal segment of either lower lobe from the remaining basal segments

• Plain radiographs -> visible 10%
  • Extending superiorly and medially from the medial third of the hemidiaphragm

• CT -> visible 15%
  • Extending laterally and anteriorly from the region of the inferior pulmonary ligament to join the major fissure
Inferior accessory fissure

- Large arrows -> separates the medial basal segment of the lower lobe from the remainder of the basal segments
- Small arrows -> major fissure; anteriorly
superior accessory fissure

• Demarcates the superior segment from the remainder of the lower lobe
• More common on the right
• Seen at about same level the minor fissure

Left minor fissure

- Present approximately 10% of normal lungs
- Separating the lingula from the remainder of the left upper lobe
- Visible on plain radiographs in about 1%
- Appearing higher than the right minor fissure
Left minor fissure

- Left minor fissure (large arrows)
  - Separates the lingular segments from the remainder of the upper lobe
- Small arrows = the major fissure

Inferior pulmonary ligaments and phrenic nerves

IASLC lymph node map

1 = low cervical, supraclavicular and sternal notch nodes
2 = upper paratracheal nodes
3 = pre-vascular and retrotracheal nodes
4 = lower paratracheal nodes
5 = subaortic/aortopulmonary nodes
6 = para-aortic nodes
7 = subcarinal nodes
8 = para-oesophageal nodes
9 = pulmonary ligament nodes
10 = hilar nodes
11 = inter lobar nodes
12 = lobar nodes
13 = segmental nodes
14 = sub segmental nodes

The International Association for the Study of Lung Cancer
IASLC lymph node map

- Ao-aorta, AV-azygos vein, Br-bronchus, IA-innominate artery, IV-innominate vein, LA-ligamentum arteriosum, LIV-left innominate vein, LSA-left subclavian artery, PA-pulmonary artery, PV-pulmonary vein, RIV-right innominate vein, SVC-superior vena cava

References

• David M Hansell, Imaging of diseases of the chest. – 5th ed., 2010


Thank you