Thoracic Radiology

A Guide for Beginners

Iacopo Carbone
Michele Anzidei
Editors

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To Livia, Anna, Caterina, Raffaello and Lucia: the bright stars of my own private sky.

Iacopo Carbone

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Contents

Anatomy of the Thorax

1

Isabella Ceravolo, Michele Anzidei, and Susan Dababou

Trachea and Main Bronchi (Fig. 1.1)

The trachea has a cylindrical shape flattened posteriorly and is composed of 15–20 cartilaginous rings joined together by annular ligaments.
The trachea originates at the level of the C6–C7 vertebrae about 4 cm below the hyoid bone, extends for about 10–12 cm and branches into right and left main

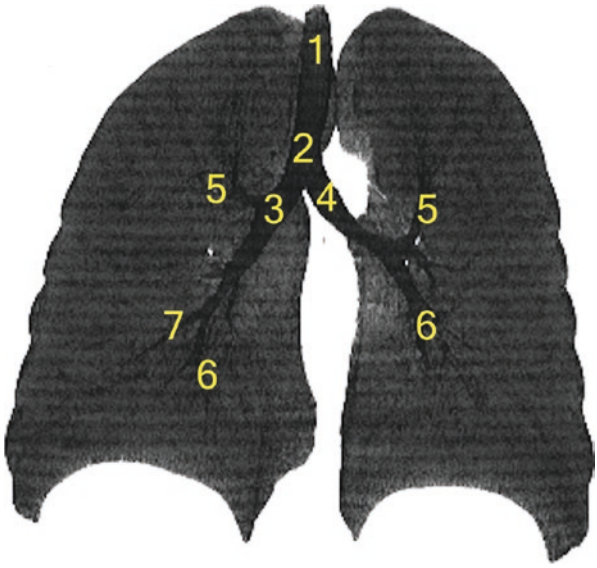

Fig. 1.1 (1) Trachea, (2) Carina of trachea, (3) Right bronchus, (4) Left bronchus, (5) Superior lobar bronchus, (6) Inferior lobar bronchus, (7) Middle lobar bronchus

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bronchi at the level of T3–T4. This reference point at the base of the trachea is known as the carina.

Fissures and Lung Lobes

Lung fissures divide the lung parenchyma in anatomically and functionally independent lobes. The left lung is composed of two lobes (upper and lower) demarcated by the oblique fissure. The right lung has three lobes (upper, middle, and lower) separated by two fissures: the minor fissure (or horizontal fissure), which passes horizontally between the upper and middle lobes, and the major fissure (or oblique fissure), which separates the upper and middle lobes from the lower lobe (Figs. 1.2, 1.3, and 1.4).

Bronchopulmonary Segments (Fig. 1.5)

Bronchopulmonary segments are anatomically and functionally independent units within the lobes with an own ventilation (segment of the bronchus), vascular supply (branches of the pulmonary artery) and venous drainage. The anatomy of the bronchi and segments is illustrated in Figs. 1.6 and 1.7.

Mediastinal Compartments (Fig. 1.8)

The mediastinum is located in the median portion of the thorax and is bounded by the sternum and vertebral column anteroposteriorly, the mediastinal portion of the parietal pleura of both lungs laterally, the diaphragm inferiorly and by a horizontal plane passing through the first thoracic vertebra and the superior margin of the first rib superiorly. The mediastinum can be divided into four compartments:

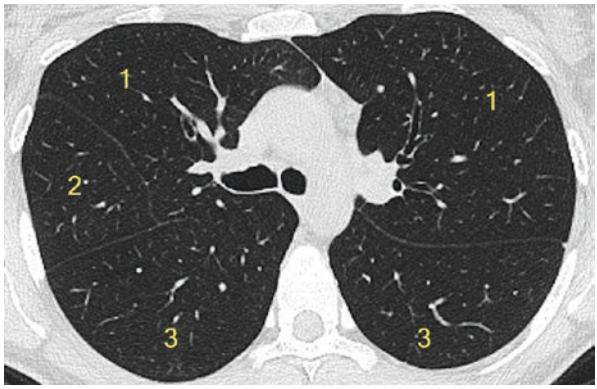

Fig. 1.2 (1) Upper lobe, (2) Middle lobe, (3) Lower lobe

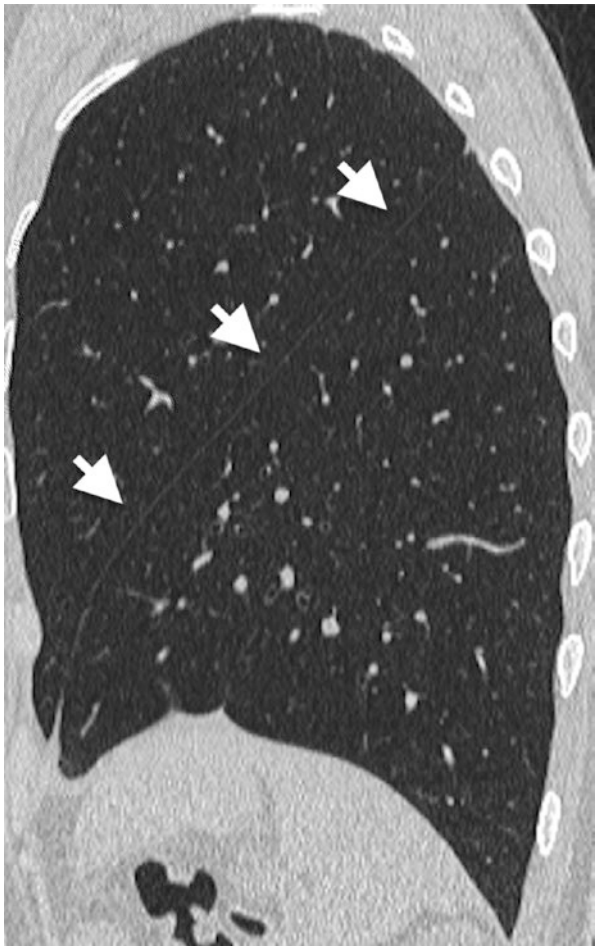

Fig. 1.3 CT scan, left lung lobe—The major fissure, or oblique fissure, (*white arrows*) originates in the superior portion of the hilum, runs upwards and backwards, passes the posterior margin, crosses the lateral surface, and descends obliquely up to the base. Then, it crosses the base and continues on the medial surface to end in the inferior part of the hilum

- The **anterior mediastinum** (prevascular space) includes the thymus, internal mammary vessels, pericardium, sternopericardial ligaments, loose connective tissue, and lymph nodes.
- The **superior mediastinum** contains the aortic arch, brachiocephalic trunk, left common carotid artery, left subclavian artery, the upper parts of the superior vena cava, thoracic duct, esophagus and trachea, lymph nodes, and adipose tissue.
- In the **middle mediastinum** (vascular space) we can find the heart, pericardium, ascending aorta, pulmonary arteries and veins, superior and inferior vena cava, the phrenic, vagus and recurrent laryngeal nerves, the carina, main bronchi, and lymph nodes.
- The **posterior mediastinum** contains the descending aorta, esophagus, thoracic duct, azygos and hemiazygos veins, nervous structures, and lymph nodes.

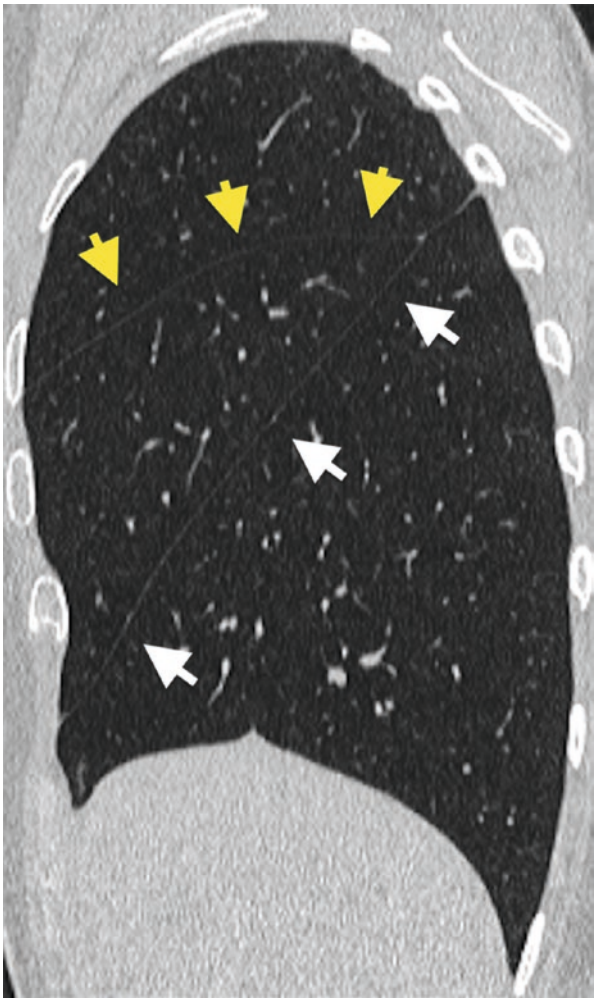

Fig. 1.4 CT scan, right lung lobe—The oblique fissure (*white arrows*) separates the upper and middle lobes form the lower lobe. The minor fissure, or horizontal fissure (*yellow arrow*), separates the right upper lobe from the middle lobe. The horizontal fissure separates from the oblique fissure at the level of the fourth rib, crosses horizontally the lateral surface of the lung, passes the anterior margin, and runs obliquely upwards ending at the hilum

Lymph Node Stations

Recognizing lymph node stations is crucial to stage cancers and decide the correct therapeutic approach. In 2014, the International Association for the Study of Lung Cancer (IASLC) proposed the following map for assessing lymph node stations (Figs. 1.9 and 1.10):

Supraclavicular Zone

Station 1: Low cervical, supraclavicular, and sternal notch lymph nodes—Station 1 is limited by the inferior margin of the cricoid cartilage superiorly and by

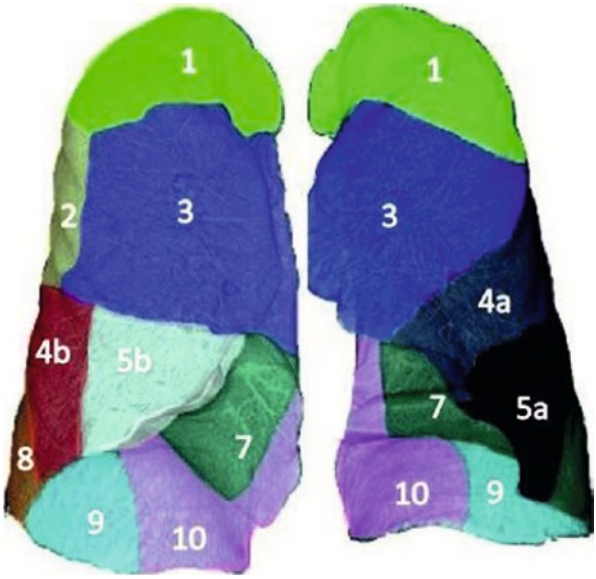

Fig. 1.5 Right Lung. Upper lobe: (1) Apical segment, (2) Posterior segment, (3) Anterior segment. Middle lobe: (4b) Lateral segment, (5b) Medial segment. Lower lobe: (8) Anterior basal segment, (9) Lateral basal segment, (7) Medial basal segment, (10) Posterior basal segment. Left Lung. Upper lobe: (1) Apicoposterior segment, (3) Anterior segment, (4a) Superior lingular segment, (5a) Inferior lingular segment. Lower lobe: (7) Anteromedial basal segment, (9) Lateral basal segment, (10) Posterior basal segment

the clavicles and the superior margin of the manubrium inferiorly. The median axis of the trachea separates the right and left lymph node stations.

Upper Zone

Station 2R: Right upper paratracheal lymph nodes—The superior border of this region is the apex of the right lung laterally and the superior border of the manubrium medially. The inferior border corresponds to the plane passing through the intersection between the caudal margin of the brachiocephalic vein and the median axis of the trachea.

Station 2L: Left upper paratracheal lymph nodes—The superior border is the apex of the left lung laterally and the superior border of the manubrium medially. The inferior border is at the level of the superior margin of the aortic arch.

Station 3A: Prevascular lymph nodes—The superior border of the prevascular zone is the thoracic apex, whereas the inferior border is at the level of the carina. Anteriorly, it is delimited by the posterior wall of the sternum; posteriorly, it is limited by the anterior border of the superior vena cava on the right and by the carotid artery on the left.

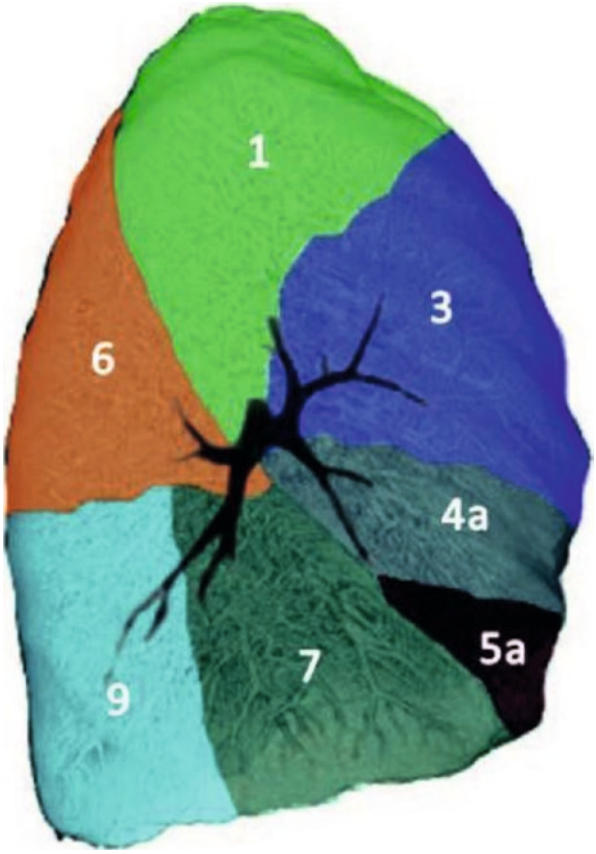

Fig. 1.6 Left Lung. Upper lobe: (1) Apicoposterior, (3) Anterior, (4a) Superior lingular, (5a) Inferior lingular. Lower lobe: (6) Superior, (7) Anteromedial basal, (9) Lateral basal

Station 3P: Retrotracheal lymph nodes—These lymph nodes are located in the retrotracheal space. The superior boundary of this region is the thoracic apex, the inferior one is at the level of the carina.

Station 4R: Right lower paratracheal lymph nodes—This region is bounded by the intersection between the margin of the brachiocephalic vein and the trachea superiorly and by the inferior margin of the azygos vein inferiorly.

Station 4L: Left lower paratracheal lymph nodes—The upper edge is the superior margin of the aortic arch. The lower one is the superior margin of the left pulmonary artery.

Aortopulmonary Zone

Station 5: Subaortic lymph nodes—The upper border of the aortopulmonary window is the inferior margin of the aortic arch, and the lower border is the superior margin of the left pulmonary artery.

Station 6: Para-aortic lymph nodes—These nodes run anterolaterally to the ascending aorta and the aortic arch.

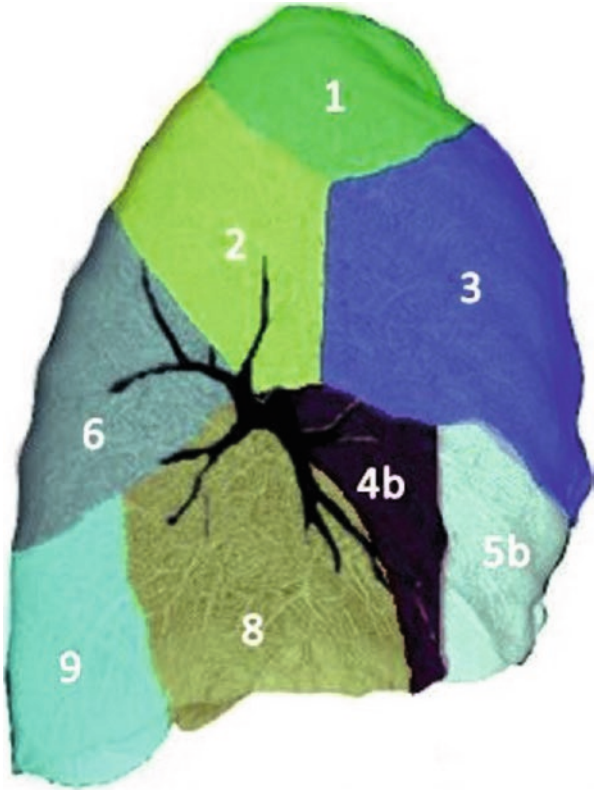

Fig. 1.7 Right Lung. Upper lobe: (1) Apical, (3) Anterior, (2) Posterior. Middle lobe: (4b) Lateral, (5b) Medial. Lower lobe: (6) Superior, (8) Anterior basal, (9) Lateral basal

Subcarinal Zone

Station 7: Subcarinal lymph nodes—The upper border is the carina and the inferior margin of the trachea. The edge of the lower bronchus on the left and of the intermediate bronchus on the right constitute the lower border.

Lower Zone

Station 8: Paraesophageal lymph nodes—They lie adjacent to the esophagus, extending from the inferior margin of the left lower and the right intermediate bronchus to the diaphragm.

Station 9: Pulmonary ligament lymph nodes—They are located along the pulmonary ligament, from the inferior pulmonary vein to the diaphragm.

Hilar and Interlobar Zone

Station 10: Hilar lymph nodes—They descend adjacent to the main bronchi and the hilar vessels. Superiorly, they extend to the lower margin of the azygos vein on