

# PULMONARY PEDICLES

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#### **I - INTRODUCTION:**

The pulmonary pedicles are formed by the extrapulmonary segment of the bronchial, vascular, or nerve elements that enter or exit the lungs.

Each pedicle consists of a functional pedicle, which includes: the bronchus, the pulmonary artery, and the pulmonary veins, and a nourishing and trophic pedicle, which includes: the bronchial vessels, bronchial nerves, and lymphatics.

#### **II - CONSTITUENT ELEMENTS OF THE PEDICLE:**

#### 1. Functional pedicle:

- A- THE BRONCHI
- They originate from the tracheal bifurcation at the level of T4, towards the back, at the height of the Louis angle, and slightly to the right of the midline.
- The two bronchi diverge, forming an angle of approximately 70°.

#### Right main bronchus:

- It extends from the tracheal bifurcation to the superior lobar bronchus; it is almost vertical (slightly oblique downward and outward).
- It has a length of **2 to 3 cm** and a diameter of **12 to 14 mm**.

#### Notes:

- It is the typical site for foreign bodies.
- It is easily explored via endoscopy.
  - It successively gives rise to the **lobar bronchi**: **superior**, **middle**, and **inferior**.

#### Superior lobar bronchus:

- It originates from the outer aspect of the **main bronchus**. It travels outward and slightly upward, almost horizontally, toward the upper part of the **hilum**.
- It divides into:

- 1. Apical segmental bronchus of the superior lobe.
- 2. Dorsal segmental bronchus.
- 3. Ventral segmental bronchus.

#### Middle lobar bronchus:

- It originates from the **anterior face** of the **main bronchus**. It travels forward, downward, and slightly outward.
- It divides into:
- 4. Lateral segmental bronchus.
- 5. Medial segmental bronchus.

#### Inferior lobar bronchus:

- It represents the termination of the **main bronchus** below the **middle lobar bronchus**, almost entirely intra-hilar.
- It travels downward, outward, and backward.
- It divides into:
- 6. Apical segmental bronchus of the inferior lobe (or Nelson's apical bronchus).
- 7. Mediobasal segmental bronchus (or paracardiac segmental bronchus).
- 8. Ventrobasal segmental bronchus.
- 9. Laterobasal segmental bronchus.
- 10. Dorsobasal segmental bronchus (or terminal basal bronchus).

#### Left main bronchus:

- It extends from the tracheal bifurcation to the superior lobar bronchus, and is almost horizontal.
- It has a length of **5 to 6 cm** and a diameter of **9 to 11 mm**.

*Note*: It is difficult to explore with rigid endoscopy.

- It gives off the **superior lobar bronchus**, then continues as the **inferior lobar bronchus**.

#### Superior Lobar Bronchus:

- It originates from the **anterolateral face** of the **main bronchus**. It travels upward and outward toward the **upper part of the hilum**.
- It divides into two trunks:
  - Culminal bronchus (superior) (BC) divides into three segmental bronchi:
- 1. Apical segmental bronchus of the superior lobe.
- 2. Dorsal segmental bronchus.
- 3. Ventral segmental bronchus.
  - Lingular bronchus (inferior) (BL) divides into two segmental bronchi:
- 4. Cranial lingular bronchus.
- 5. Caudal lingular bronchus.

#### Inferior Lobar Bronchus:

- It represents the termination of the **main bronchus** below the **superior lobar bronchus**, and it directs obliquely downward and outward.
- It presents the same segments as the **right inferior lobar bronchus** (segments 6 to 10).



#### **B- PULMONARY ARTERIES**

- The right and left pulmonary arteries originate from the bifurcation of the pulmonary trunk.

#### Note:

- Their path and distribution are well studied using pulmonary angiography.
- They can be affected by pulmonary arterial hypertension, which may complicate the natural course of certain cardiac conditions, particularly:
  - Congenital heart diseases
  - Acquired left heart diseases
  - Chronic respiratory failure

- They divide into lobar, segmental, and subsegmental arteries.
- Overall, the arterial system follows the bronchial system. Each bronchus is accompanied by a satellite artery, which supplies the same territory, forming broncho-arterial pedicles.

#### Pulmonary artery trunk

- It originates at the pulmonary orifice, located at the base of the right ventricle.
- It measures 5 cm in length and 30 mm in diameter.
- It courses posteriorly, to the left, and slightly upward, terminating behind the left border of the ascending aorta, where it bifurcates into right and left branches.

#### Right pulmonary artery

- It is longer and larger than the left pulmonary artery, measuring **5 cm in length** and **22 mm in diameter**.
- It transverses the mediastinum, passing:
  - **Behind** the ascending aorta and the superior vena cava.
  - **Above** the transverse pericardial sinus.
  - **Below** the aortic arch and the arch of the azygos vein.
  - In front of the tracheal bifurcation.
- It enters the right lung hilum, positioned anterior and inferior to the origin of the superior lobar bronchus.
- It curves, passing above and then behind the middle lobar bronchus.
- It descends along the posterolateral border of the inferior lobar bronchus.
- It terminates at the posterior surface of the posterior basal segmental bronchus.
- Branches of the right pulmonary artery:
- For the right upper lobe: typically two or three arteries:
  - **Mediastinal artery of the right upper lobe**: gives a branch for each segment of the upper lobe.
  - **One or two fissural arteries**: generally supplying the dorsal segment.
- For the right middle lobe: usually two arteries, originating from the right pulmonary artery at the depth of the fissure, each supplying one of the two middle lobe segments.

- For the right lower lobe: Typically, one artery per segment:
  - Apical segment artery.
  - Basal segment artery.





#### Left pulmonary artery

- It is shorter (3 cm) and smaller in diameter (18 mm) than the right pulmonary artery.
- From its origin, it is immediately part of the left pulmonary pedicle.
- It ascends in an almost sagittal direction, passing in front of:
  - The left main bronchus.
  - **Above** the left upper lobar bronchus.
- It then descends along the posterior surface of the left upper lobar bronchus and continues along the posterolateral border of the left lower lobar bronchus.
- It terminates at the posterior surface of the posterior basal segmental bronchus.
- It supplies the two lobes of the left lung.
- Branches of the left pulmonary artery :
- For the left upper lobe: Usually four arteries:
  - Apico-dorsal artery (or superior mediastinal artery).

- Ventral artery (or anterior mediastinal artery).
- **Two fissural arteries**, originating at the depth of the fissure:
- ✓ **Dorsal fissural artery** (supplying the dorsal segment).
- ✓ Lingular fissural artery.
- For the left lower lobe:
  - Apical segmental artery for the lower lobe.
  - **Basal artery**, branching to supply each segment of the basal pyramid.





#### **C- PULMONARY VEINS**

- The origin veins, or perilobular veins, arise from the perialveolar network and, to a lesser extent, from the peribronchial and subpleural networks.
- Inside the lung, the veins are located at the periphery of parenchymal territories, within the interlobular septa, and then in the intersegmental (or perisegmental) planes.

*Note:* They serve as an important landmark for *intersegmental dissection*.

- Each side drains into two pulmonary veins, each formed by the confluence of two main tributaries.

#### Right lung veins:

#### **Right superior pulmonary vein:**

- Drains the upper and middle lobes.

- Positioned in the anteroinferior part of the pulmonary pedicle.
- Formed by the union of two tributaries:
  - Superior tributary: drains the upper lobe.
  - Inferior tributary: drains the middle lobe.
- **Important variation:** In cases of incomplete fissure, the interlobar veins may receive blood from adjacent lobes.

#### Right inferior pulmonary vein:

- Drains the lower lobe.
- Located at the inferior part of the pulmonary pedicle.
- Formed by the union of two **tributaries**:
  - Superior tributary.
  - Inferior tributary.

#### Left lung veins:

- Their arrangement is similar to that of the right lung veins.

#### Left superior pulmonary vein:

- Drains the upper lobe.
- **Important variation:** One of the lingular veins may drain into the left inferior pulmonary vein.

#### Left inferior pulmonary vein:

- Drains the lower lobe, following a pattern similar to the right inferior pulmonary vein.
- **Important variation:** The two left pulmonary veins may merge into a single common trunk before emptying into the left atrium.

**Note:** This anatomical variation should always be considered during lobectomy, as it is more frequent on the left than on the right.

## **Pulmonary arteries and veins**

Posterior view



#### 2. Nourishing pedicle:

#### A- BRONCHIAL VESSELS

The **bronchial vessels** provide the nutrient vascular supply to the lung and are subject to significant anatomical variations.

#### **Bronchial arteries:**

**Note:** They have been studied using selective arteriography, particularly in the context of lung transplantation.

#### Right side:

- There is usually a single right bronchial artery, which typically arises from a bronchialintercostal trunk.
- It crosses the esophagus (most often posteriorly) and reaches the posterior surface of the right main bronchus, where it branches.
- Occasionally, a second right bronchial artery (prebronchial artery) may be present.

#### Left side:

- There are typically two left bronchial arteries, classified as superior and inferior.
- They generally originate directly from the descending thoracic aorta (or from the inferior aspect of the aortic arch).
- They rapidly reach the left main bronchus.

#### **Bronchial veins:**

There are two bronchial veins on each side:

#### Posterior bronchial vein:

- Travels posterior to the bronchus.
- Drains into:
  - Right side: Azygos vein or an intercostal vein.
  - Left side: Superior hemiazygos vein.

#### Anterior bronchial vein:

- Located **anterior** to the **main bronchus**.
- Drains into either:
  - A pulmonary vein.
  - The azygos vein (on the right) or the superior hemiazygos vein (on the left).



#### D- LYMPHATICS :

#### Lymph nodes of the pulmonary pedicles:

- These lymph nodes are located between the bronchovascular elements.
- They are classified into:

#### Anterior lymph nodes: located in front of the bronchial plane.

- **Prevenous node**: positioned anterior to the inferior pulmonary vein.
- **Prearterial node**: located anterior to the pulmonary artery.
- **Prebronchial nodes**: situated in front of the bronchus, just before the origin of the upper lobar bronchus.

- Posterior lymph nodes: positioned on the posterior aspect of the bronchus.
- Superior lymph nodes: located above the bronchial plane.
- Inferior lymph nodes: aligned along the inferior border of the bronchus.

#### Intrapulmonary lymph nodes:

- These lymph nodes are situated along the path of the pulmonary lymphatic collectors, which also pass through the pedicle and drain into:
- On the right side:
  - Right anterior mediastinal chain.
  - Right laterotracheal chain.
  - Intertracheobronchial chain.
- On the left side:
  - Left anterior mediastinal chain.
  - Left laterotracheal chain.
  - Intertracheobronchial group.



#### E- BRONCHIAL NERVES

- The bronchial nerves are arranged into two plexuses:
  - Anterior plexus
  - Posterior plexus
- They are formed by **pulmonary branches** of the **sympathetic nervous system** and the **vagus nerves (pneumogastric nerves)**.



#### **III - ANATOMICAL RELATIONS:**

- 1. Right pulmonary pedicle:
- a. Mediastinal segment:

The mediastinal segment is related to:

- Anteriorly:
- Superior vena cava, which largely conceals the pedicle; its terminal part is enclosed in the pericardium, over which the right phrenic nerve descends, accompanied by the right superior phrenic vessels.
- Superiorly:
  - Arch of the azygos vein.
  - Right laterotracheal lymphatic chain (arch ganglion).

- Posteriorly:
  - Azygos vein, before forming its arch.
  - Right vagus nerve, which later becomes retro-oesophageal.

#### - Inferiorly:

• Triangular ligament, with the inferior vena cava and right atrium just in front.

#### **b.** Hilar segment:

At this level, it corresponds to the margins of the hilar fossa, which are lined with pleura that invaginates into the fossa.

#### 2. Left pulmonary pedicle:

#### a. Mediastinal segment:

The left pulmonary pedicle is shorter and less extensive than the right. It corresponds to:

- Anteriorly:
  - The aortic arch, with its initial part encased in the pericardium, on which the left phrenic nerve descends, accompanied by the superior phrenic vessels.
- Superiorly:
  - The aortic arch, sometimes leaving an impression on the bronchus.
  - The left recurrent laryngeal nerve, looping under the aortic arch.
  - The ligamentum arteriosum.

#### - Posteriorly:

- The descending thoracic aorta.
- The esophagus.
- The thoracic duct.
- The left vagus nerve, which gives off the left recurrent laryngeal nerve before moving to the anterior surface of the oesophagus.

- Inferiorly:
  - The triangular ligament, with the left atrium and left ventricle just anterior to it.

#### a. Hilar segment:

The relations are the same as on the right. However:

- The hilum is more central and positioned higher.
- There are only two lobar pedicles.

#### **IV - CLINICAL APPLICATIONS:**

#### Haemoptysis:

- Haemoptysis is defined as red, aerated blood of subglottic origin expelled through the mouth during a cough effort.
- It indicates the passage of blood from the thoracic vascular system into the airway and serves as an alarm symptom requiring urgent aetiological investigation. Severe haemoptysis is life-threatening due to the risk of asphyxia.
- Thoracic imaging is crucial, with volumetric CT angiography providing a comprehensive, non-invasive assessment.
- Endovascular treatment is the first-line invasive approach, primarily involving bronchial artery embolisation (in over 90% of cases), with pulmonary artery vaso-occlusion being necessary in fewer than 10% of cases.

#### **V - CONCLUSION:**

Knowledge of the pulmonary pedicle anatomy is very important for:

- Understanding certain cardiopulmonary pathologies.
- Interpreting thoracic radiological exams.
- Performing certain therapeutic interventional procedures.