Trachea,Oesophagus and Thoracic Duct

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Introduction

The **trachea**, **oesophagus**, and **thoracic duct** are the principal midline structures within the **superior and posterior mediastina** of the thoracic cavity.
They form the vital airway, food passage, and lymphatic drainage channels connecting the head and neck with the thoracoabdominal region.

Trachea

Extent and Course

- The **trachea** (windpipe) is a **fibrocartilaginous tube** forming the **lower part of the respiratory passage**.
- Extends from the **lower border of the cricoid cartilage (C6)** to the level of the **sternal angle (T4/T5)**, where it divides into the **right and left principal bronchi** (tracheal bifurcation).
- Length: **10–12 cm**
- Diameter: **2 cm in adults**

Parts

1. **Cervical Part:**
   Lies in the neck, in front of the oesophagus, extending from **C6 to the thoracic inlet**.

2. **Thoracic Part:**
   Lies within the **superior mediastinum**, descending to the **level of T4/T5**, where it bifurcates at the **carina**.

Relations of the Trachea

Anteriorly:

- Skin, fascia, isthmus of thyroid gland (2nd–4th tracheal rings)
- Inferior thyroid veins
- Arch of aorta (below)
- Brachiocephalic trunk and left brachiocephalic vein
- Thymus (in children)

Posteriorly:

- **Oesophagus**

On Each Side:

- **Right side:** Azygos vein, right vagus nerve, pleura, and SVC.
- **Left side:** Arch of aorta, left common carotid and subclavian arteries, and left recurrent laryngeal nerve.

Structure of the Trachea

- Composed of **16–20 C-shaped hyaline cartilaginous rings**.

- The **open posterior part** is closed by the **trachealis muscle** (smooth muscle), allowing flexibility and diameter adjustment.
- The rings prevent collapse during inspiration.

Blood Supply

- **Arterial:**
  - Inferior thyroid artery (cervical part)
  - Bronchial arteries (thoracic part)
- **Venous Drainage:**
  - Inferior thyroid veins and bronchial veins.

Lymphatic Drainage

- **Pretracheal** and **paratracheal lymph nodes**, draining ultimately to **deep cervical nodes**.

Nerve Supply

- **Sensory and secretomotor:** Vagus nerve.
- **Sympathetic fibers:** From middle cervical ganglion (for vasomotor control).

Histology of Trachea

Mucosa:

- Lined by **pseudostratified ciliated columnar epithelium** with **goblet cells** (respiratory epithelium).
- Contains **basal cells** (stem cells), **brush cells**, and **small granule cells**.
- **Cilia** move mucus upward toward the pharynx (mucociliary escalator).

Lamina Propria:

- Loose connective tissue with **seromucous glands**, lymphoid tissue, and blood vessels.

Submucosa:

- Rich in **seromucous glands** producing mucus for lubrication.

Cartilaginous Layer:

- Contains **hyaline cartilage rings**, providing structural rigidity.

Adventitia:

- Connective tissue binding trachea to adjacent structures.

Clinical Anatomy

1. **Tracheostomy:**
    - Surgical opening made between **2nd and 4th tracheal rings** to establish an airway.
    - The **isthmus of the thyroid gland** is often divided or retracted during the procedure.

2. **Foreign Body in Trachea:**
    - Objects tend to enter the **right bronchus** (wider, shorter, and more vertical).
    - May cause **coughing, choking, and respiratory distress**.
3. **Tracheitis and Bronchitis:**
    - Inflammation of the tracheal mucosa, often viral or bacterial.
    - Leads to **productive cough** and irritation due to involvement of mucous glands.
4. **Tracheal Stenosis:**
    - Narrowing due to **prolonged intubation**, trauma, or congenital defect.
5. **Compression Syndromes:**
    - **Aortic aneurysm**, **enlarged thyroid (goitre)**, or **mediastinal tumors** can compress the trachea ? **dyspnea or stridor**.
6. **Carina:**
    - The ridge at the tracheal bifurcation (most sensitive area of trachea).
    - Stimulates **cough reflex** when irritated; displaced in **lung collapse or tumor**.
7. **Tracheoesophageal Fistula:**
    - Congenital or acquired abnormal communication between **trachea and oesophagus**, leading to **choking during feeding**.
8. **Tracheomalacia:**

- Weakness of tracheal cartilages leading to **collapse during respiration**, especially in infants.

9. **Bronchoscopy:**
    - Diagnostic procedure to visualize the **tracheobronchial tree**, remove foreign bodies, or take biopsy samples.

10. **Intubation:**

- Endotracheal tube insertion to maintain airway during anesthesia or respiratory failure.

The trachea's structural balance between **rigidity (cartilage)** and **flexibility (trachealis muscle)** allows uninterrupted airflow, while its **mucociliary system** ensures a clean, protected airway — a design elegant in both function and simplicity.

Oesophagus

Extent and Parts

The **oesophagus** is a **muscular tube about 25 cm long** that connects the **pharynx (C6)** to the **stomach (T11)**.
It passes through the **neck, thorax, and diaphragm**, entering the abdomen through the **oesophageal opening at T10** level.

Parts:

1. **Cervical part** – from C6 to thoracic inlet
2. **Thoracic part** – from thoracic inlet to diaphragm
3. **Abdominal part** – from diaphragm to cardiac end of stomach (about 1.25 cm long)

Course and Relations

In the neck:

- Lies behind trachea and in front of vertebral column.
- Laterally related to recurrent laryngeal nerves and carotid sheath.

In the thorax:

- Initially lies behind trachea and then behind left atrium.
- Shows three normal constrictions:
    - At **cricoid cartilage** (C6)
    - Where it is **crossed by aortic arch** (T4)
    - Where it passes through **diaphragm** (T10)

Anterior relations: Trachea (above), left atrium (below)
Posterior relations: Vertebral column, thoracic duct, aorta (below)

To the left: Aortic arch, left subclavian artery, thoracic duct, left pleura and lung
To the right: Azygos vein, right pleura and lung

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Arterial Supply

- **Cervical part:** Inferior thyroid arteries
- **Thoracic part:** Oesophageal branches of aorta

- **Abdominal part:** Oesophageal branches of left gastric artery

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Venous Drainage

- Upper part ? **Brachiocephalic veins**
- Middle part ? **Azygos vein**
- Lower part ? **Left gastric vein** (portal system)
  ? Site of **porto-systemic anastomosis**, significant in **portal hypertension**

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Lymphatic Drainage

- Cervical ? Deep cervical nodes
- Thoracic ? Posterior mediastinal nodes
- Abdominal ? Left gastric nodes

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Nerve Supply

- **Parasympathetic:**
  - Upper half – Recurrent laryngeal nerves

- Lower half – Oesophageal plexus (from vagus) ? forms anterior & posterior gastric nerves
  ? Function: Motor, sensory, and secretomotor

- **Sympathetic:**
  - From middle cervical ganglion (upper part) and upper thoracic ganglia (lower part)
    ? Function: Vasomotor

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Histology of Oesophagus

The oesophagus is specialized for rapid propulsion of food.

Mucosa:

- **Epithelium:** Stratified squamous non-keratinized — protective.
- **Lamina propria:** Rich in connective tissue with papillae and lymphoid elements.
- **Muscularis mucosae:** Indistinct in upper part, distinct in lower part.

Submucosa:

- Contains **mucus-secreting glands** (oesophageal glands proper).

Muscularis externa:

- **Upper third:** Striated muscle
- **Middle third:** Mixed (striated + smooth)

- **Lower third:** Smooth muscle

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Adventitia:

- Loose connective tissue with blood vessels and nerves

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Clinical Anatomy

1. **Oesophageal Varices:**
   - Dilatation of lower oesophageal veins in **portal hypertension** due to portal-systemic anastomosis.
   - May rupture ? **haematemesis** (vomiting of blood)

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2. **Tracheo-Oesophageal Fistula:**
   - Congenital failure of separation between trachea and oesophagus ? **choking during feeding**

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3. **Achalasia Cardia:**
   - Failure of lower oesophageal sphincter to relax ? **dysphagia and regurgitation**, due to **absence of ganglion cells**

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4. **Oesophageal Compression:**
    - **Mediastinal tumors** or **aortic aneurysm** cause dysphagia (difficulty swallowing)

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5. **Barium Swallow Study:**
    - Demonstrates **three normal constrictions** and detects **strictures, carcinoma, or varices**.
    - **Left atrial enlargement** produces indentation on anterior wall of oesophagus

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6. **Endoscopy:**
    - Used for **biopsy, stricture dilation, or foreign body removal**; knowledge of constrictions essential to avoid perforation

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Thoracic Duct

Features

The **thoracic duct** is the **largest lymphatic vessel** in the human body.
It extends from the **upper abdomen to the lower part of the neck**, traversing the **posterior and superior mediastina**.
Length: **approximately 45 cm (18 inches)**.
It shows a **beaded appearance** due to numerous **valves** in its lumen

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Course

- **Origin:** Continuation of the **cisterna chyli**, located near the **lower border of T12 vertebra**.
- **Entry into Thorax:** Through the **aortic opening of the diaphragm**.
- **Posterior Mediastinum:** Ascends from **T12 to T5**, lying **between the aorta (left)** and **azygos vein (right)**, anterior to the **vertebral column**.
- At **T5**, it **crosses from the right to the left** side, ascending along the **left edge of the oesophagus**.
- **Superior Mediastinum:** Continues upward on the **left side of the oesophagus**.
- **In the Neck:**
    - Arches laterally at the level of **C7 transverse process**.
    - Curves downward **in front of the first part of the left subclavian artery**.
    - **Termination:** Opens into the **left venous angle**, i.e., the junction between the **left subclavian** and **left internal jugular veins**

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Relations

At the Aortic Opening of the Diaphragm

- **Anteriorly:** Diaphragm

- **Posteriorly:** Vertebral column
- **Right side:** Azygos vein
- **Left side:** Aorta

In Posterior Mediastinum

- **Anteriorly:** Diaphragm, oesophagus, right pleural recess
- **Posteriorly:** Vertebral column, right posterior intercostal arteries, terminal parts of hemiazygos veins
- **Right side:** Azygos vein
- **Left side:** Descending thoracic aorta

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In Superior Mediastinum

- **Anteriorly:** Arch of aorta, origin of left subclavian artery
- **Posteriorly:** Vertebral column
- **Right side:** Oesophagus
- **Left side:** Pleura

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In the Neck

- **Anteriorly:** Left common carotid artery, left vagus nerve, left internal jugular vein

- **Posteriorly:** Vertebral artery and vein, sympathetic trunk, thyrocervical trunk, left phrenic nerve, medial border of scalenus anterior, prevertebral fascia, and first part of left subclavian artery

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Tributaries

The thoracic duct drains lymph from:

- **Both sides below the diaphragm**, and
- **Left side above the diaphragm** (i.e., left side of head, neck, thorax, and left upper limb).

Specific Tributaries:

- **Posterior mediastinal lymph vessels**
- **Intercostal lymph vessels**
- **Left jugular trunk** – drains left side of head and neck
- **Left subclavian trunk** – drains left upper limb
- **Left bronchomediastinal trunk** – drains left thoracic viscera

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Clinical Anatomy

1. **Chylothorax:**

- Leakage of lymph (chyle) into the pleural cavity due to **injury or rupture of the thoracic duct** during surgery or trauma.

- Manifests as **milky pleural effusion** rich in fat.

2. **Obstruction of Thoracic Duct:**

   - May result from **malignancy (e.g., lymphoma)**, **tuberculosis**, or **fibrosis**, causing **lymphedema** of the left arm, left face, and lower body.

3. **Congenital Absence or Duplication:**

   - Rare anomalies affecting drainage pattern, sometimes leading to **bilateral chylothorax**.

4. **Surgical Relevance:**

   - Thoracic duct must be preserved during **neck dissections**, **oesophageal surgeries**, or **mediastinal procedures** to prevent postoperative chyle leak.