

# Trachea, Oesophagus and Thoracic Duct

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## Trachea, Oesophagus and Thoracic Duct

### 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.

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### 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**

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### 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**.

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### 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.

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### 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.

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## Blood Supply

- **Arterial:**

- Inferior thyroid artery (cervical part)
- Bronchial arteries (thoracic part)

- **Venous Drainage:**

- Inferior thyroid veins and bronchial veins.

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## Lymphatic Drainage

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

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## Nerve Supply

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

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## 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.

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### **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.

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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**

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### **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:**

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

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## 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

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### 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.