THE THORACIC DUCT

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I – INTRODUCTION:

The thoracic duct is the body's main lymphatic collector. It drains all the lymph from the subdiaphragmatic region and the lymph from the left half of the supradiaphragmatic region.

II - DESCRIPTIVE ANATOMY:

1. Origin:

- The thoracic duct originates from the confluence of the two lumbar lymphatic trunks and the intestinal trunk.

- Its origin varies:

- Sometimes, it is high, **intrathoracic**, located just anterior to T11 or T12.
- Sometimes, it is low, **intra-abdominal**, just anterior to **L1 or L2.** In this case, its origin is often dilated, forming a variably shaped enlargement, sometimes ampullary, known as the **cisterna chyli**.

2. Course:

- In its **thoracic segment** (and possibly a short **abdominal segment**), the thoracic duct ascends almost vertically in the posterior mediastinum, with a slightly oblique upward-leftward course, particularly at the level of T4-T5.
- In its cervical segment, after passing through the superior thoracic aperture, it follows a concave curve downward, forward, and to the left.

Note: *Its course is highly variable, which explains why the thoracic duct is susceptible to injury during thoracic or cervical surgery.*

3. Termination:

The thoracic duct drains into the **left jugulo-subclavian confluence** or one of its two contributing veins, in a variable manner:

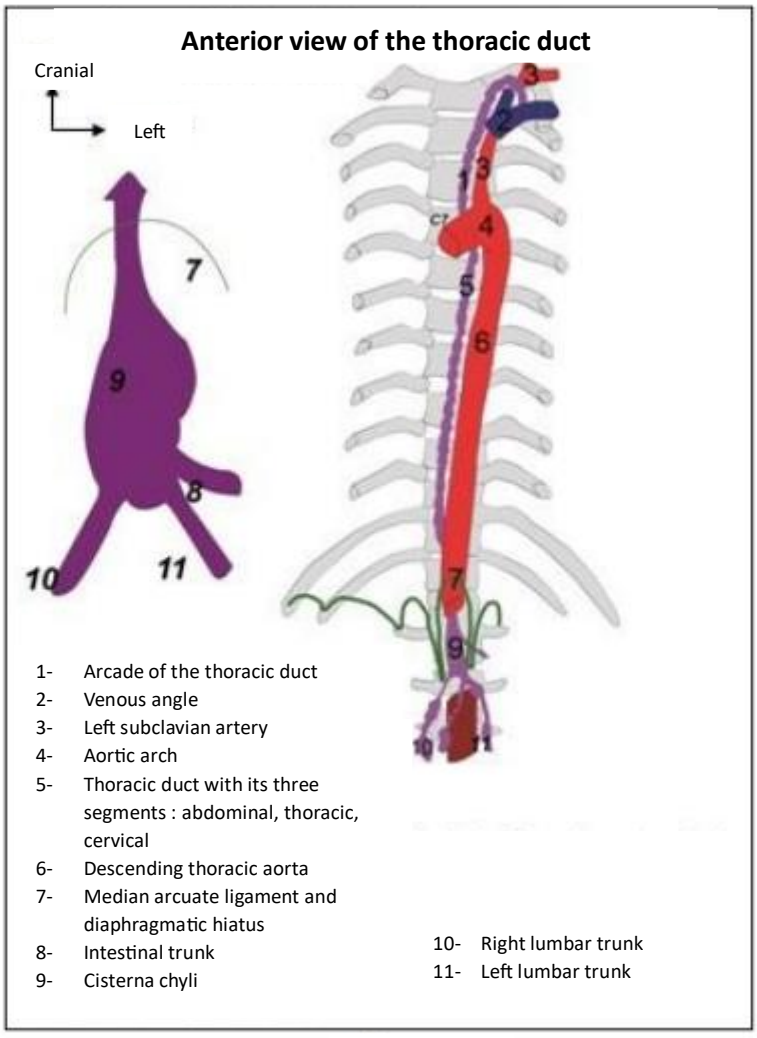
- Perpendicularly to the vein wall, thus opposing the bloodstream.
- Obliquely, after a short course within the venous adventitia, which prevents reflux in cases of valvular insufficiency.

4. Positioning:

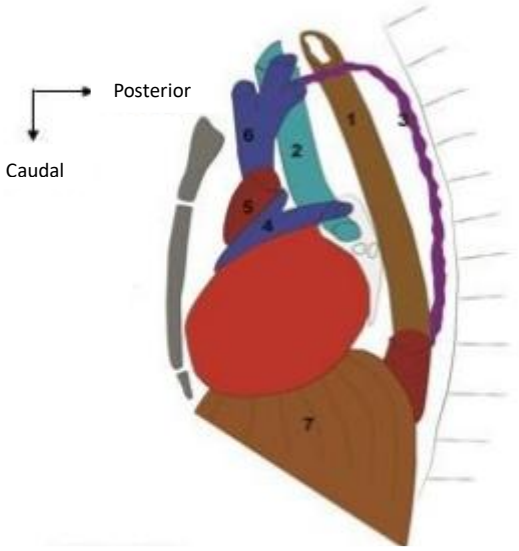
- The **abdominal segment** is deep, prevertebral, and retro-aortic.

- The **thoracic segment** (the longest) is located far posteriorly in the posterior mediastinum.

- The **cervical segment** is positioned in the lower and inner part of the left omoclavicular triangle (left supraclavicular fossa).



Left view of the mediastinum after aortic resection, showing the thoracic duct



1- Esophagus
2- Trachea
3- Thoracic duct
4- Thoracic aorta
5- Left jugulosubclavian venous confluence
6- Left diaphragmatic dome

5. External configuration:

The thoracic duct appears as a long, grayish-white conduit, with a consistency roughly similar to that of a vein.

6. Internal configuration:

- It contains **valves**, though few in number, which prevent lymph and chyle reflux, particularly near its extremities.

- The **lower end** may have two valves or just one, which can sometimes be insufficient.

7. Dimensions:

- Its **length** is approximately **30 cm**.

- Its **caliber** remains fairly constant along its course, except for **dilatations at both extremities**:

- The **chyle cistern** at its **origin**.

- The **thoracic duct ampulla** at its **termination**.

III – ANATOMICAL RELATIONS:

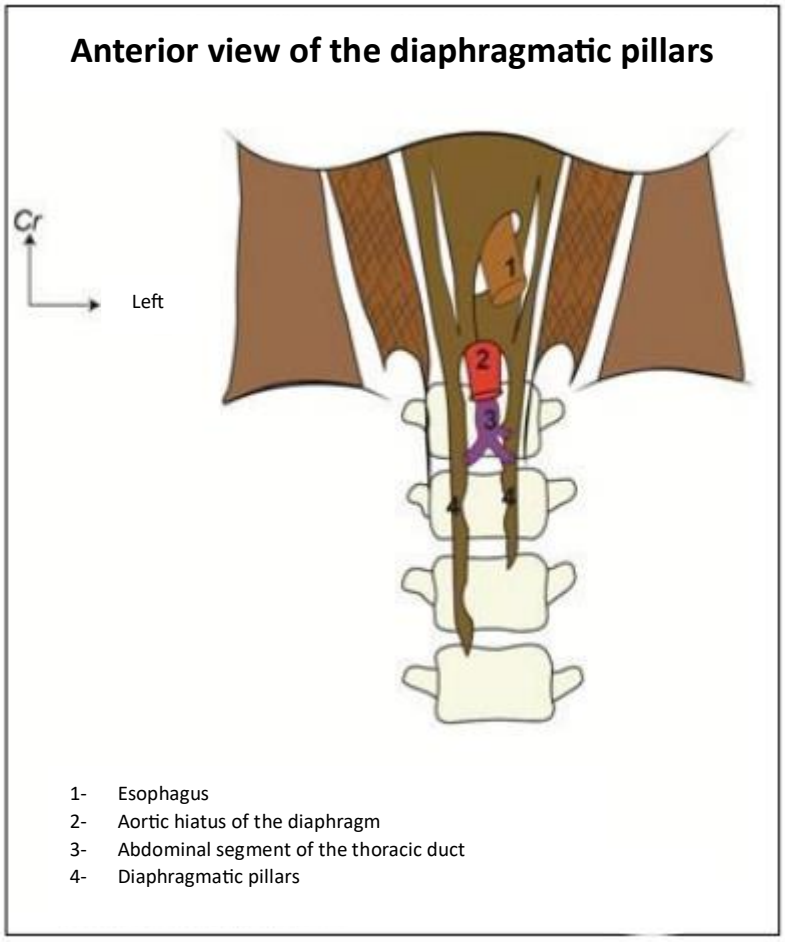
1. Abdominal segment :

This segment is inconstant, prevertebral, and retro-aortic.

Note: *It may be injured in cases of vertebral fractures or during aortography via the translumbar approach.*

2. Diaphragmatic passage:

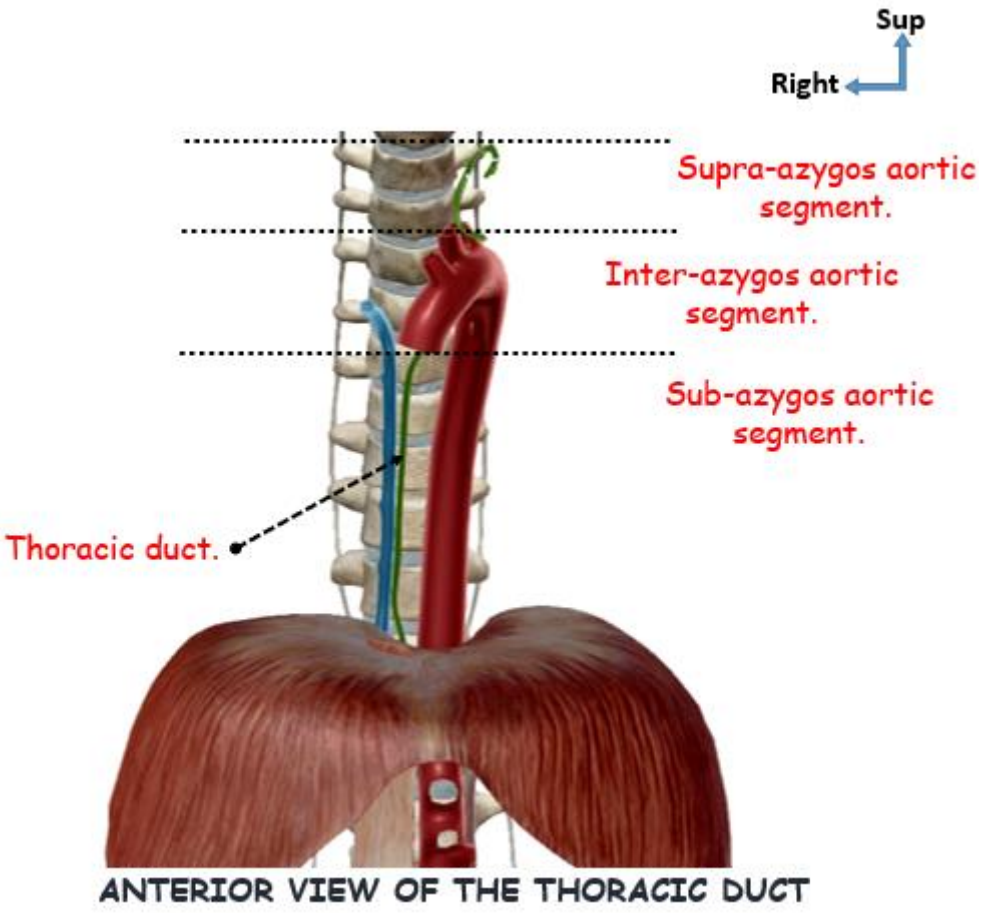
The thoracic duct is positioned behind the right border of the aorta within the aortic hiatus of the diaphragm, sharing its anatomical relations.



3. Thoracic segment:

This **longest segment** of the thoracic duct is entirely within the posterior mediastinum and can be subdivided into three portions:

- **Sub-azygos-aortic segment** (below the azygos vein and aorta).
- **Inter-azygos-aortic segment** (between the azygos vein and aorta).
- **Supra-azygos-aortic segment** (above the azygos vein and aorta).



a. Sub-azygos-aortic segment:

The thoracic duct is related to:

- **Posteriorly:**
  - Right posterior intercostal arteries.
  - Hemiazygos veins, which cross transversely to drain into the azygos vein.
  - Further back, the vertebral column (T12–T5) covered by the anterior longitudinal ligament.
- **Anteriorly:**
  - The aorta (inferiorly).
  - The esophagus, along whose posterior surface the right vagus nerve runs.
- **Laterally:**
  - The azygos vein (right), which receives the right posterior intercostal veins.

- The descending thoracic aorta (left), giving off posterior intercostal arteries.

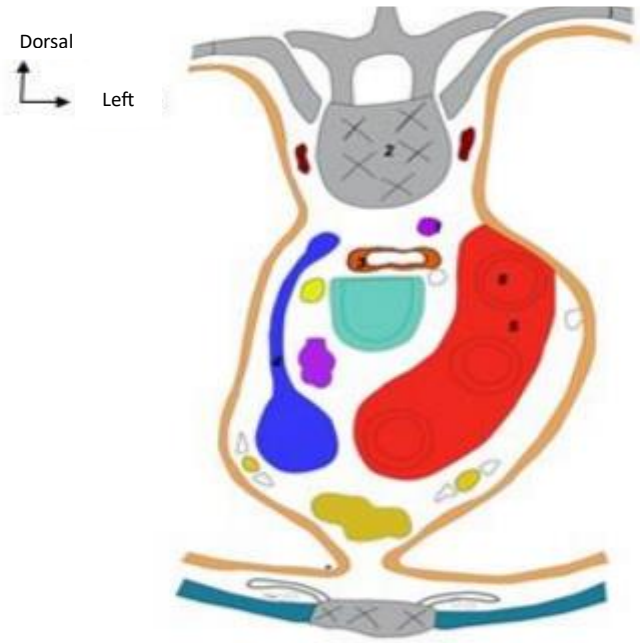
Note: *The thoracic duct bisects the angle formed by the azygos vein and the descending aorta.*

b. Inter-azygos-aortic segment:

The thoracic duct bends leftward and is related to:

- **Posteriorly:**
  - The 4th thoracic vertebra.
- **Anteriorly:**
  - The esophagus, which it crosses from right to left along the posterior surface.
  - The right bronchial artery.
- **Laterally:**
  - The azygos vein arch (right, at some distance).
  - The aortic arch (left).

Relations of the thoracic duct in a horizontal section at T4



1- Thoracic duct
2- T4
3- Esophagus
4- Azyogs vein arch
5- Aortic arch
6- Left subclavian artery

c. Supra-azygos-aortic segment:

The thoracic duct runs along the posteromedial surface of the left subclavian artery, sharing its anatomical relationships:

- **Posteriorly:**
  - The 2nd and 3rd thoracic vertebrae.
- **Anteriorly and to the left:**
  - The left subclavian artery, covered by the pleura.
- **To the right:**
  - The oesophagus (its main relationship).
  - The trachea (more anterior).
  - The left recurrent laryngeal nerve (with its associated lymphatic chain), running in the tracheo-oesophageal sulcus.

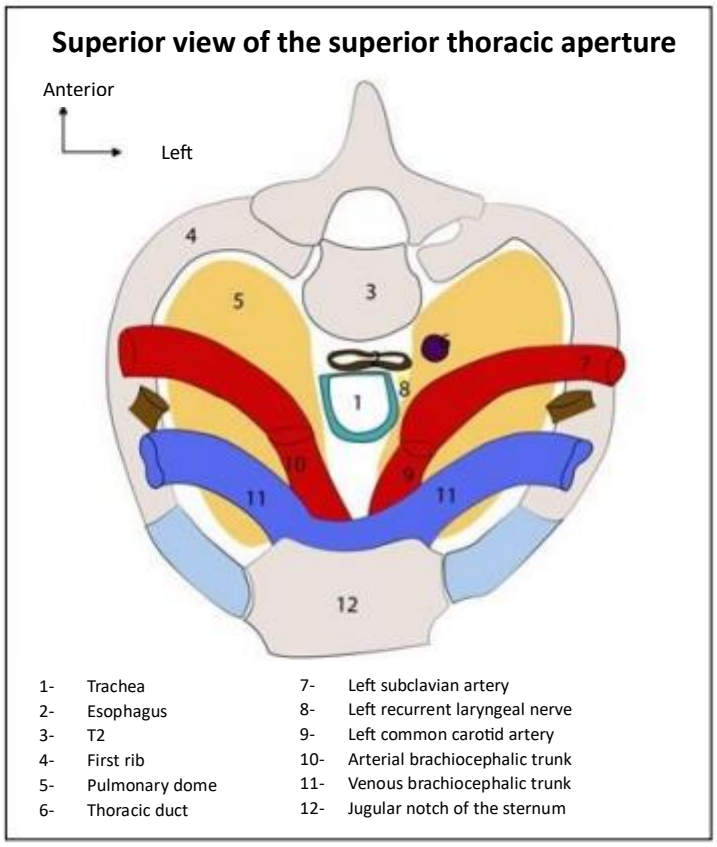
4. At the superior thoracic aperture:

The thoracic duct crosses the superior thoracic aperture, which is bounded by:

- **Posteriorly:** The second thoracic vertebra (T2).
- **Anteriorly:** The jugular notch of the sternum.
- **Laterally:** The first rib.

It occupies a very posterior and left paramedian position, with the following relationships:

- **Anteriorly:**
    - The oesophagus (on the right) and the left subclavian artery (on the left).
    - The trachea and the pretracheal vasculonervous structures, located more anteriorly.
- **Laterally:** The left pleural dome, with:
    - **Posteriorly:** The supra- and retro-pleural recess, close to the thoracic duct.
    - **Anteriorly:** The lower part of the omoclavicular triangle.



5. Cervical segment:

The thoracic duct forms its arch in the lower part of the small supraclavicular fossa, positioned between:

- **Below:** The first rib.
- **Medially:** The cervical oesophagus.

It remains distant from the superficial layers, including:

- The skin and subcutaneous tissue.
- The lower part of the sternocleidomastoid muscle, enclosed by the superficial layer of the cervical fascia.
- The omohyoid muscle, enclosed by the pretracheal layer of the cervical fascia.

Its main relationships are vascular, as the thoracic duct appears between:

- **Medially and anteriorly:**
    - The main neurovascular bundle of the neck: the common carotid artery, the internal jugular vein, and the vagus nerve.
- **Laterally and posteriorly:**
    - The vertebral bundle.
- **Superiorly:**
    - The inferior thyroid artery.
- **Inferiorly:**
    - The subclavian vessels, with the thoracic duct crossing over the artery before reaching the jugulo-subclavian venous confluence.

Summary: It appears very medial, in close proximity to the esophagus and the lymph nodes surrounding the internal jugular vein.

Note: *The thoracic duct may be injured during cervical lymph node dissection.*

IV – COLLATERAL BRANCHES AND COLLATERAL PATHWAYS:

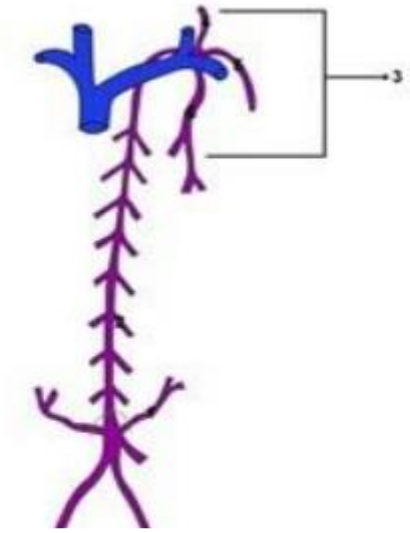
1. Collateral branches:

The thoracic duct receives numerous collateral lymphatic vessels:

- **Phrenic lymphatics.**
- **Thoracic lymphatics:** intercostal and posterior mediastinal pathways.
- **Cervical lymphatics:**
    - **Jugular trunk:** draining the left half of the head and neck.
    - **Subclavian trunk:** draining the left upper limb.
    - **Broncho-mediastinal trunk:** draining the heart, lungs, and the left half of the thoracic wall.

Summary: The thoracic duct drains ¾ of the body's lymphatic flow, including the entire infra-diaphragmatic region and the left half of the supra-diaphragmatic region.

Collateral branches of the thoracic duct



1- Phrenic lympathics
2- Thoracic lympathics
3- Cervical lympathics
4- Jugular trunk
5- Subclavian trunk
6- Bronchomediastinal trunk

2. Collateral pathways:

They are of two types: **accessory lymphatic pathways** and **lymphovenous anastomoses.**

a. Accessory lymphatic pathways:

Normally thin, these pathways become significant when the thoracic duct is damaged.

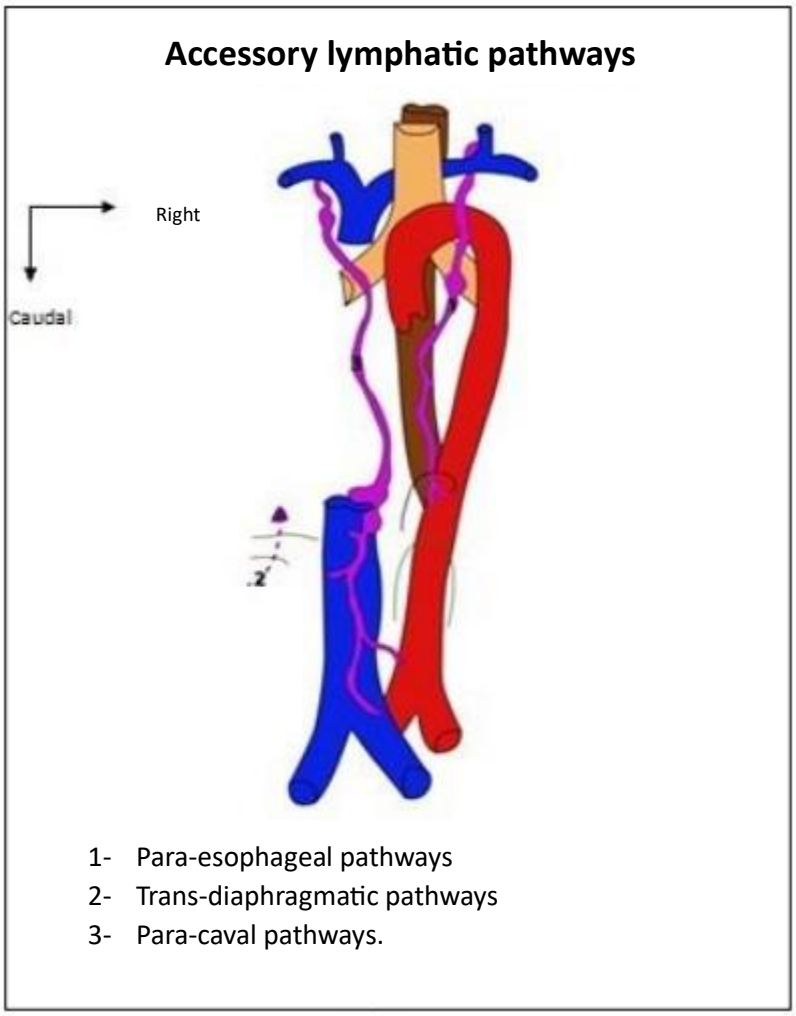
- **Para-esophageal pathways**: draining into the left broncho-pulmonary lymph nodes, then into the left jugulo-subclavian confluence.
- **Trans-diaphragmatic pathways**: perforating lymphatic trunks (Küttner).
- **Para-caval pathways**: draining into the right jugulo-subclavian confluence.
- **Para-umbilical pathway.**

***Note**: The presence of these collectors makes it possible to ligate the thoracic duct.*

b. Lymphovenous anastomoses:

They are present in 50% of cases, and can occur at various levels: **lumbar**, **renal**, **mesenteric**, **azygos**, and **inferior vena cava veins**.

***Note**: These connections explain the body's ability to tolerate certain lymphatic disruptions and the early appearance of some metastases (hepatic and pulmonary) in the progression of certain cancers.*



V - VARIATIONS:

There are numerous variations of the **thoracic duct**, which can affect:

- **Origin**: **High (thoracic)** origin or **low (abdominal)** origin, with the **cisterna chyli** being inconsistent.
- **Pathway**: **Inverted duct**, **double duct**, or **multiple ducts**, especially in the **lower** or **middle** portions of the path (a very common aspect).
  This great variability in the pathway explains why the thoracic duct can be injured in thoracic surgery (such as in coarctation repair, subclavian artery surgery, Block procedure, etc.), or in cervical surgery (lymph node dissections, esophageal surgery).
- **Termination**: **Multiple arches**, including **bilateral arches**, **right-sided arches**, etc.

VI – CLINICAL APPLICATIONS:

Tear of the thoracic duct:

Due to the thinness of its wall and its almost colorless appearance, the thoracic duct can be difficult to recognize. Therefore, it is vulnerable and may be accidentally injured during certain investigations or surgical maneuvers in the posterior mediastinum. A rupture occurring during an accident or surgery on the lung allows lymph to escape into the thoracic cavity, at a rate of 75 to 200 ml per hour. The lymph can also enter the pleural cavity and cause chylothorax. The spilled fluid can be removed using a cannula or by thoracocentesis, but in some cases, it may be necessary to ligate the thoracic duct. The lymph then joins the venous circulation through collectors that drain into the thoracic duct above the ligature.

VII - CONCLUSION:

The anatomical study of the thoracic duct is important due to the multiplicity of anatomical variations and the frequency of its pathology.