

# *The Esophagus*

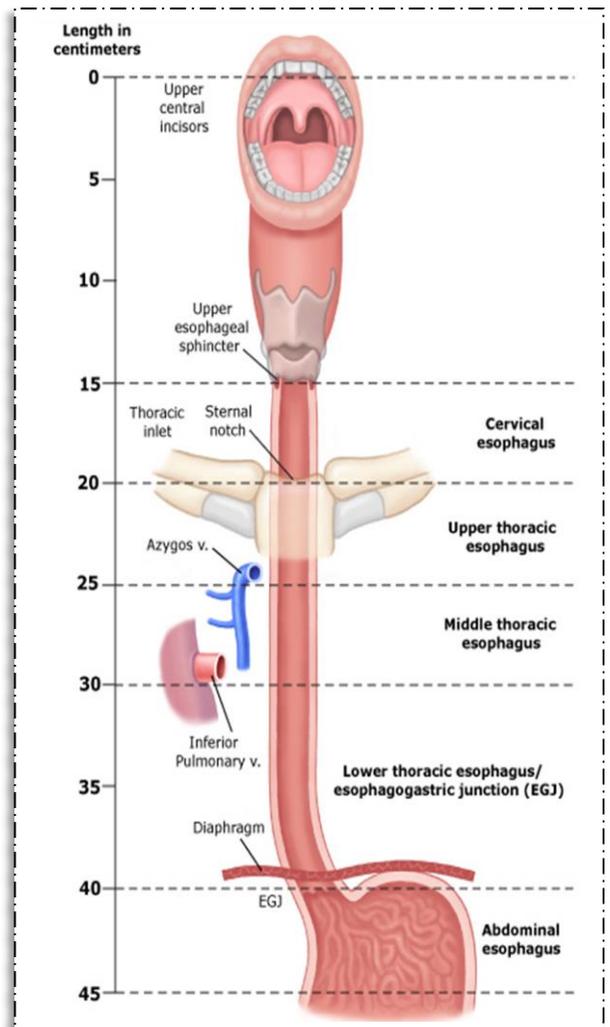
*Done by: Nabil Sweis*

- This is sort of a step-by-step “guide” that will hopefully provide sufficient clarifications and illustrations regarding part of the online lecture: The Esophagus. Each point mentioned in the slides will be explained separately. Please note that this guide seeks to clarify and facilitate visualization, so extra details may be included for this purpose. For exam purposes, the slides should be adequate. Let’s begin, shall we?

**Slide 2:** “The esophagus is a tubular structure (muscular, collapsible tube) about 10 in. (25 cm) long that is continuous above with the laryngeal part of the pharynx opposite the sixth cervical vertebra”

✓ The esophagus is basically a long “slide” for the bolus of food to have fun just before it reaches the harsh environment of the stomach. But unlike the typical slides you find in parks, this one is not plastic, it’s made of **muscle**! Let’s break down the sentence to further analyze it:

- **“a tubular structure”:** the esophagus is simply a **tube**, cylindrical in shape with a hollow interior, to allow the passage of food.
- **“muscular”:** The wall of the esophagus consists of many layers, some of which are muscular. This is important for the peristaltic movement that will propel food towards the stomach.
- **“collapsible”:** To understand this feature, imagine the esophagus as if it’s a toothpaste tube. Look at the two adjacent images:



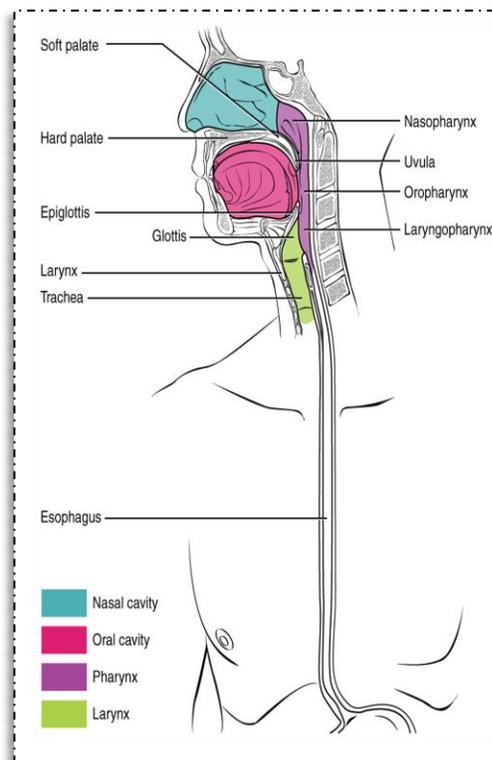
(\*This is not an advertisement for Colgate)



- Notice that the image to the left shows a normal, brand-new toothpaste tube. To the right, notice the flatness of the squeezed toothpaste tube, it's **collapsed**! This is the definition of "**collapsed**". It refers to the fact that the space inside the esophagus can be abolished by bringing the walls close to each other. So the esophagus is not a strictly firm structure, and its walls can move and change shape as part of its function.

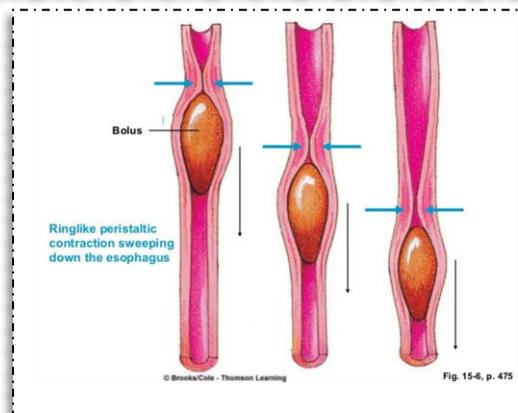
- **"continuous above with the laryngeal part of the pharynx opposite the sixth cervical vertebra":**

The esophagus does not immediately begin after the oral cavity. Recall that the swallowed bolus of food first enters an intermediate chamber (the **pharynx**) which is highlighted in purple in the adjacent image. This chamber acts like an airport. The passengers (food or air) are sorted in this chamber so that each passenger can take the right flight and reach the correct destination. If food enters this chamber, it should proceed into the esophagus. If air enters, it should usually proceed into the larynx and respiratory tract. In our context, we will focus on the esophagus, which is the path that food will have to go through to be digested later on. The pharynx is divided into nasal, oral and **laryngeal** parts. **The lowest part (laryngeal) is the one that directly communicates with the esophagus.** The esophagus starts approximately at the level of C6.



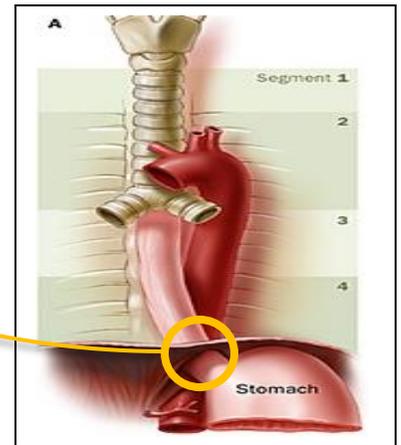
**Slide 2:** "The esophagus conducts food from the pharynx into the stomach. Wavelike contractions of the muscular coat, called peristalsis, propel the food onward"

As mentioned before, the esophagus is a passageway for food. The movement of food within the esophagus is assisted by **peristalsis**, in which contraction takes place above the bolus of food, and relaxation below, to allow the food bolus to move towards the stomach. The adjacent image may help visualize this movement.



**Slide 2:** "It passes through the diaphragm at the level of the 10<sup>th</sup> thoracic vertebra to join the stomach"

- ✓ This is best clarified through an image. As the esophagus descends downwards, it pierces the diaphragm just before reaching the stomach. The esophagus pierces the diaphragm at the level of T10.

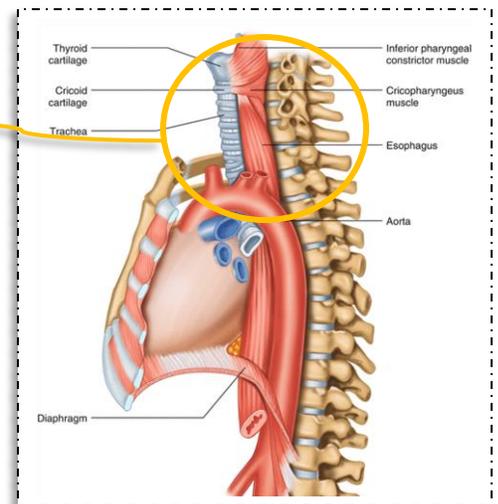


**Slide 2:** "In the neck, the esophagus lies in front of the vertebral column; laterally, it is related to the lobes of the thyroid gland, and anteriorly, it is in contact with the trachea and the recurrent laryngeal nerves"

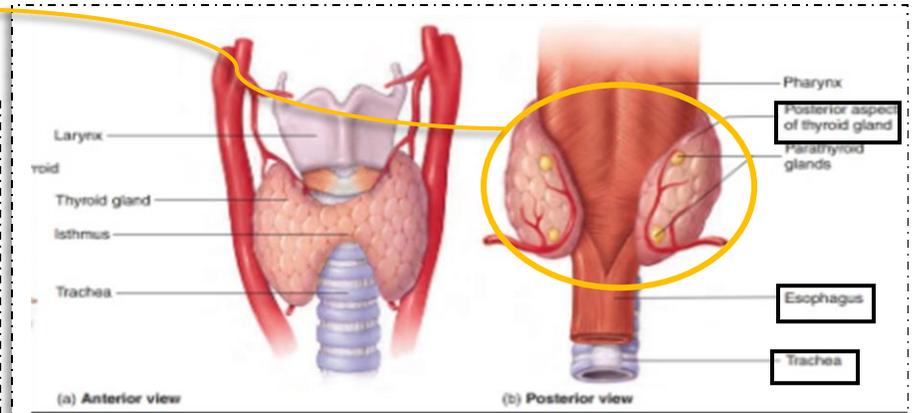
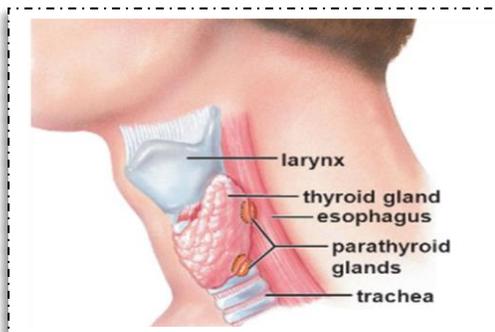
- ✓ We will first discuss the relations of the cervical part of esophagus (i.e. in the neck).

- ✓ This part needs a lot of imagination. We will need even more images to help us on this one!

- ✓ "In the neck, the esophagus lies in front of the vertebral column": The region circled in yellow represents the neck area (lateral view). Look at location of the vertebral column relative to the esophagus in the neck: The esophagus is in front!



- ✓ "laterally, it is related to the lobes of the thyroid gland": Look at the two images below. You can see how the thyroid gland lies anterior to the trachea, but the lobes extend posteriorly to the sides of the esophagus.



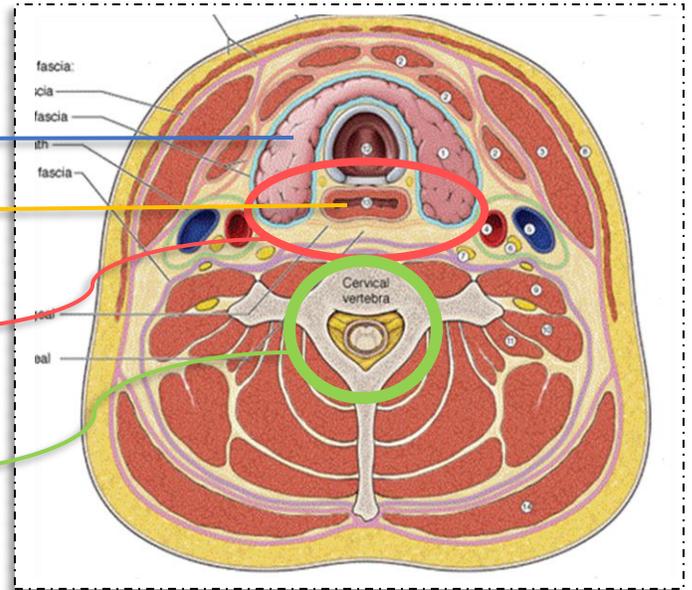
✓ Here is a superior view to further help you imagine the relations.

Thyroid gland ←

Esophagus ←

Notice the encircled region: you can see the thyroid gland at both sides of the esophagus.

You can also see the vertebral column located behind the esophagus.

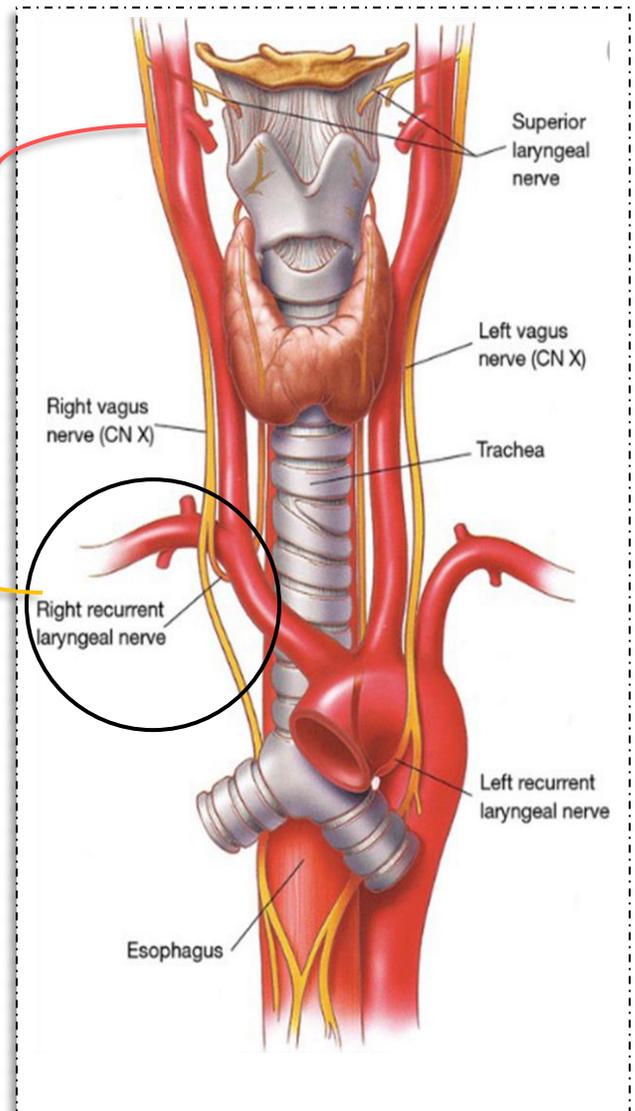


✓ "and anteriorly, it is in contact with the trachea and the recurrent laryngeal nerves":

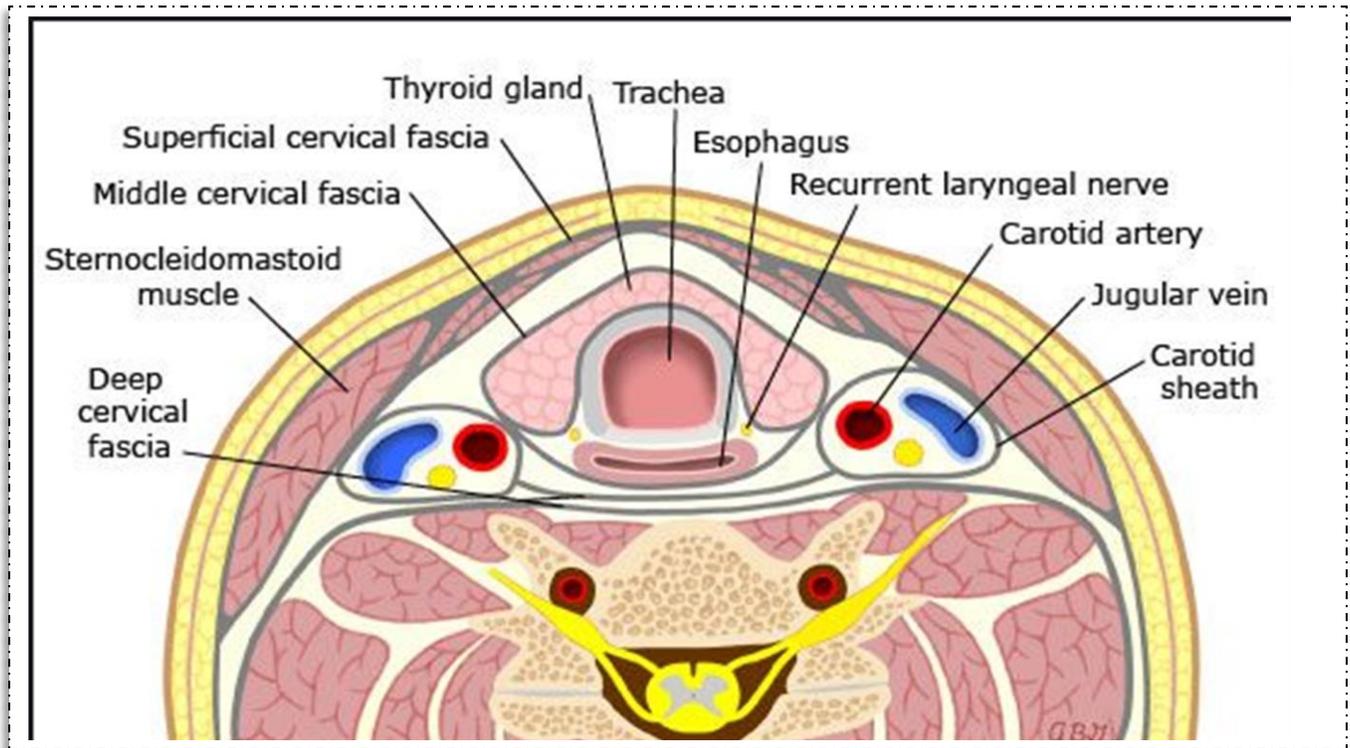
The trachea, as you might have noticed from the previous images, is anterior in position relative to the esophagus.

- Before we look at the recurrent laryngeal nerve, let's briefly talk about its origin: It is a branch from the **vagus nerve**. Recall that the vagus nerve exits the cranial cavity through the jugular foramen and descends in the neck. **At some point in its path, it gives a branch called "the recurrent laryngeal nerve"**.

It is called "recurrent" because the nerve follows a path in reverse direction. Notice that it is ascending, in contrast to its parent nerve (the vagus) which was descending. The recurrent laryngeal nerve ascends towards the larynx to supply muscles there, and during its path, it can be found anterior to the esophagus. The following image can further clarify its position. (Note that we have left and right vagus nerves, and consequently, left and right recurrent laryngeal nerves).

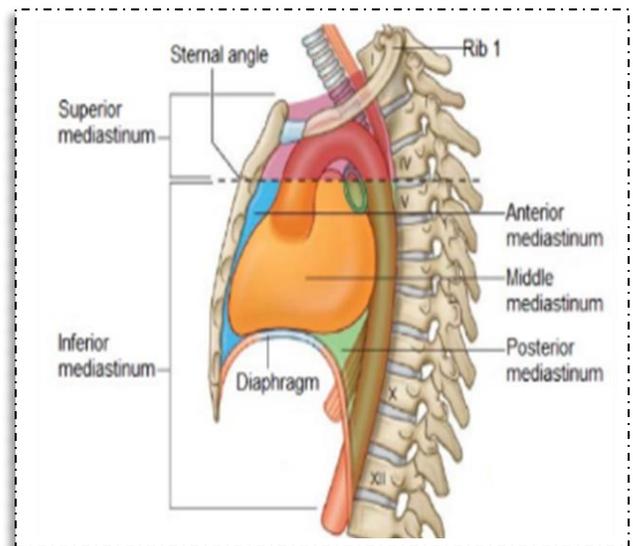


- In the following image, try to identify the structures we just discussed and describe their location relative to the esophagus. (vertebral column, thyroid gland, recurrent laryngeal nerves, trachea).



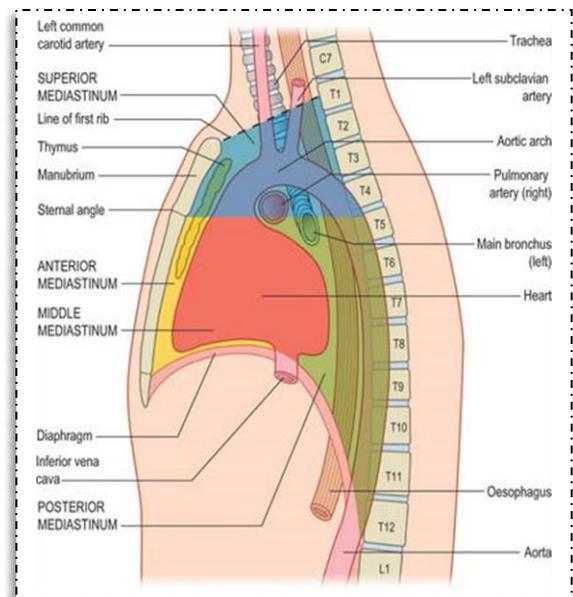
**Slide 2:** "In the thorax, it passes downward and to the left through the superior and then the posterior mediastinum.

- ✓ We finished the part of the esophagus located within the neck. Now, we will be looking at the esophagus within the thorax.
- ✓ Firstly, let's refresh our memory and define the **mediastinum**.
  - The mediastinum in its simplest definition is a cavity/space located between both lungs. One of the most important structures you can find here is **the heart!**
  - **Borders of the mediastinum:** **superiorly:** the thoracic inlet, **inferiorly:** the diaphragm, **laterally:** mediastinal pleura (or lungs for simplicity), **anteriorly:** sternum and costal cartilages, **posteriorly:** thoracic part of vertebral column.

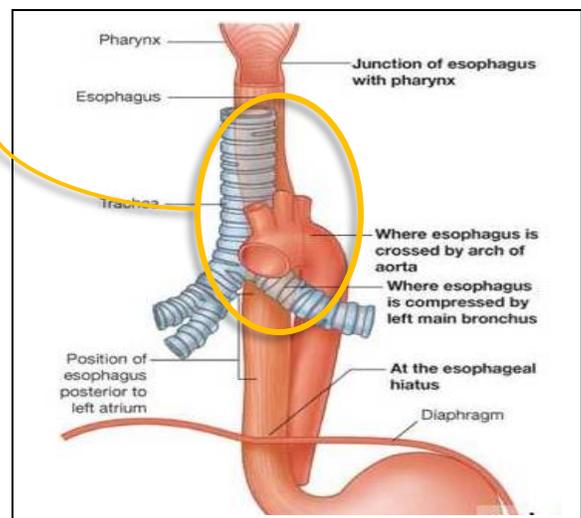


- The mediastinum is subdivided into **superior** and **inferior** parts, and the inferior part is further subdivided into **anterior**, **middle** and **posterior** parts. (the terms are color-coded to match the adjacent image).

- Ok, where were we? Oh, the esophagus within the thoracic cavity. Now that you know the different parts of the mediastinum, refer to the adjacent image and notice how the esophagus first enters the **superior mediastinum**, and then enters the inferior mediastinum, or more specifically, the **posterior mediastinum**.

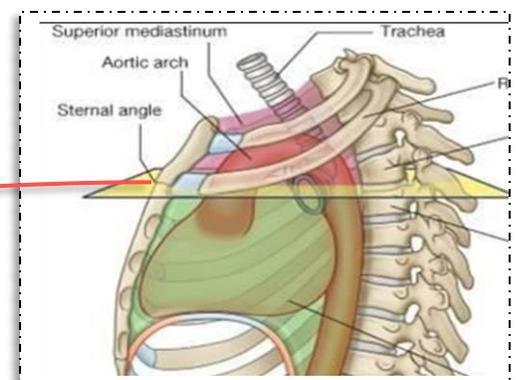


- Another important note is that the esophagus does not follow a completely vertical path. It slightly **curves to the left** as it descends (the esophagus soon returns to the midline, as will be demonstrated in the next section). (It was quite difficult to find an image that illustrates the curvature, and most images do not even show the curvature very clearly. Perhaps it is not very prominent in general. The best image I found is the one you can see to the right).



**Slide 2:** "At the level of the sternal angle, the aortic arch pushes the esophagus over to the midline"

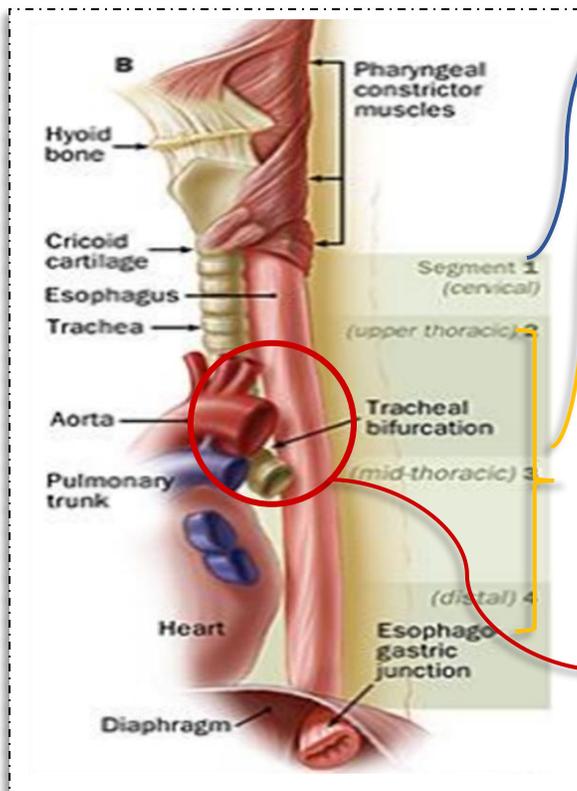
- ✓ Refer to the image in which we demonstrated the curvature of the esophagus to the left. Notice how the esophagus returns to its midline position, and this is because the aortic arch pushes the esophagus back to the midline at the level of the **sternal angle**.
- ✓ The adjacent image shows the sternal angle for those who are wondering what it is.



### Slide 3: "The relations of the thoracic part of the esophagus:

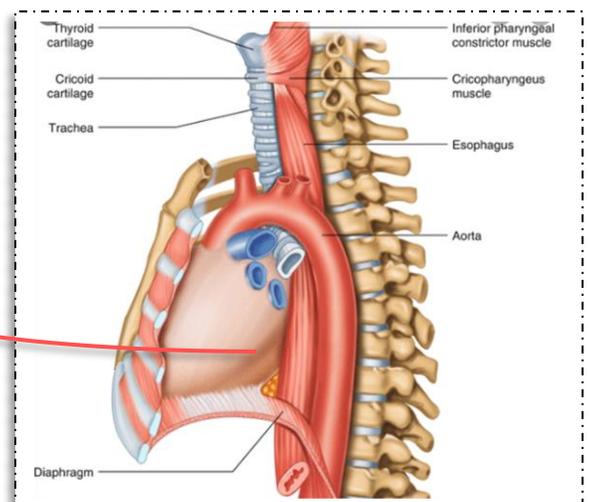
Anteriorly: The trachea and the left recurrent laryngeal nerve; the left principal bronchus, which constricts it; and the pericardium, which separates the esophagus from the left atrium"

- ✓ The esophagus, as it descends in the thoracic cavity, is related to many structures.
- ✓ Anterior to the thoracic esophagus, you can find the trachea and recurrent laryngeal nerves. These structures were also anterior to the esophagus in the neck! They lie partially in the thoracic cavity, and partially in the neck, which explains why we can see them anterior to both the cervical and thoracic esophagus.



- ✓ Notice this is the part of the esophagus which lies in the neck. You can see the trachea in front of it.
- ✓ As for the thoracic part, you can see the **trachea anterior** to the upper part of the thoracic esophagus. (This is a lateral view). Recurrent laryngeal nerves are not shown here.
- ✓ The trachea bifurcates at the level of T4, giving rise to two principal bronchi (right and left). Recall when we said the esophagus curves to the left one page ago? Well, we'll need that info here. **Due to this curvature to the left (and perhaps other anatomical reasons), the esophagus is now related to the left principal bronchus.**
- ✓ **If you look closely, you can notice how the left bronchus slightly presses against the esophagus. Thus, the left bronchus slightly constricts the esophagus here.**

- ✓ The esophagus also passes behind the heart as it descends (look at the adjacent image), more specifically behind the left atrium.
- ✓ Recall that the heart is surrounded by a fibrous coat: **The Pericardium!** This fibrous layer separates the esophagus from the **left atrium.**



**Slide 3:** "Posteriorly: The bodies of the thoracic vertebrae; the thoracic duct; the azygos veins; the right posterior intercostal arteries; and, at its lower end, the descending thoracic aorta"

✓ The esophagus is certainly a *social* organ, it has plenty of relations! Let me introduce you to the posterior friends of the thoracic esophagus:

- **The bodies of the thoracic vertebrae:** This one is pretty straightforward. You can refer to many of the previous images and see this relation. The vertebral column is a friend of many structures, that's no surprise!

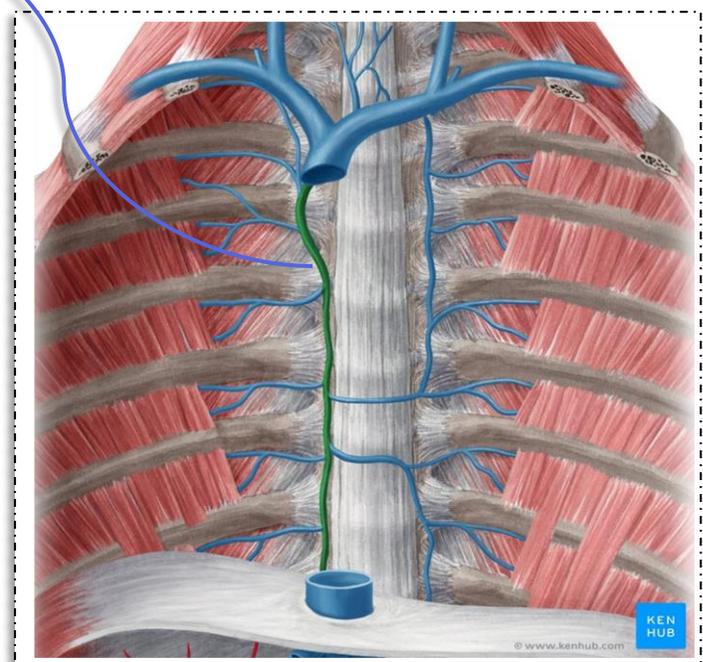
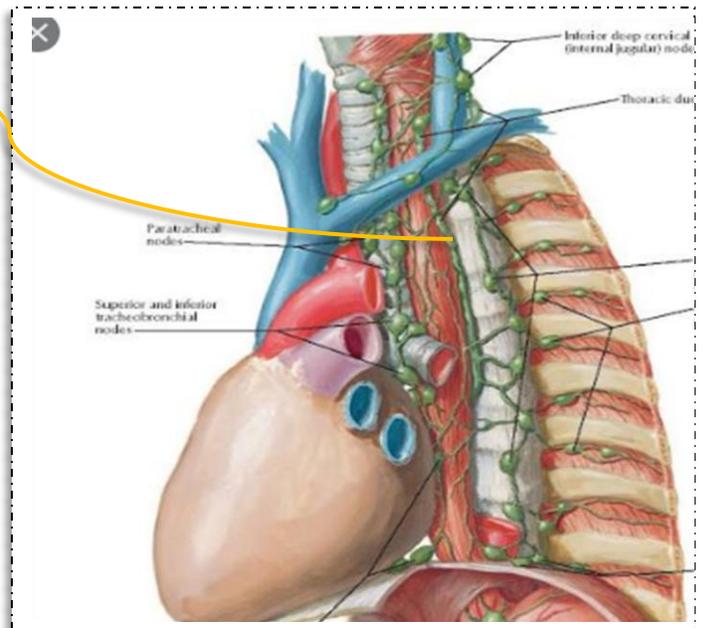
- **Thoracic duct:** This structure is responsible for collecting **lymph** if you remember. It ascends upwards to finally drain into the venous angle of the left subclavian and internal jugular veins.

- **Azygos Veins:** Name sounds scary? No worries, you'll be friends with this nice vein by the time we're over. Let's get to know him (or her, as you like) a bit to break the ice.

(It is the vein highlighted in green in bottom right image). More images are on the way (see next page)!

What's among the first questions you ask a new friend?:

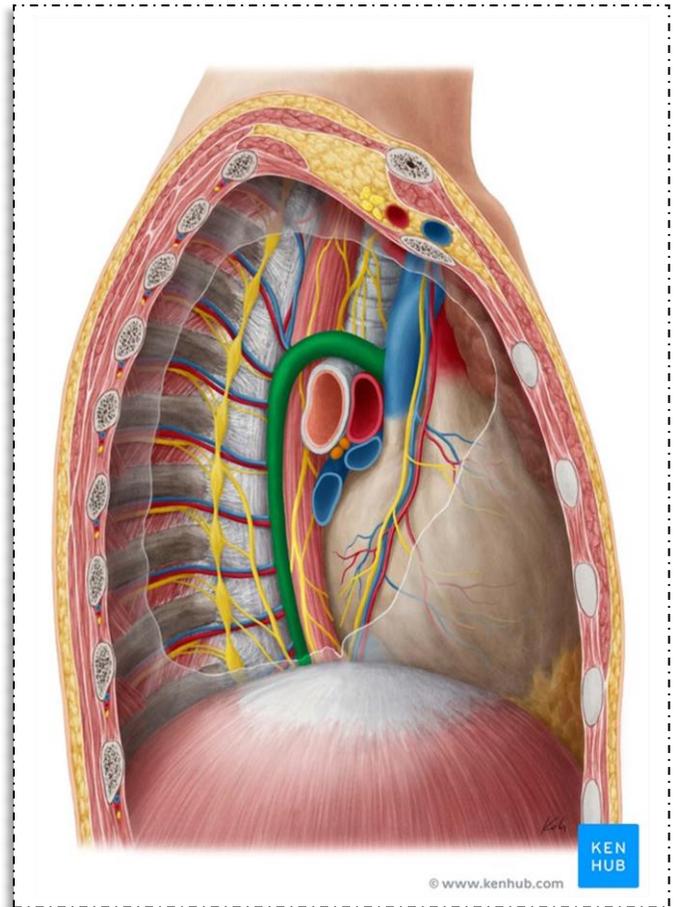
**Where are you from?** The azygos vein is variable in its origin. Let's stick with the simplest variation: It originates from the posterior aspect of the inferior vena cava, ascends vertically upwards in front of the vertebral column to finally drain into the superior vena cava. So, it originates in the abdomen, but then enters the posterior mediastinum.



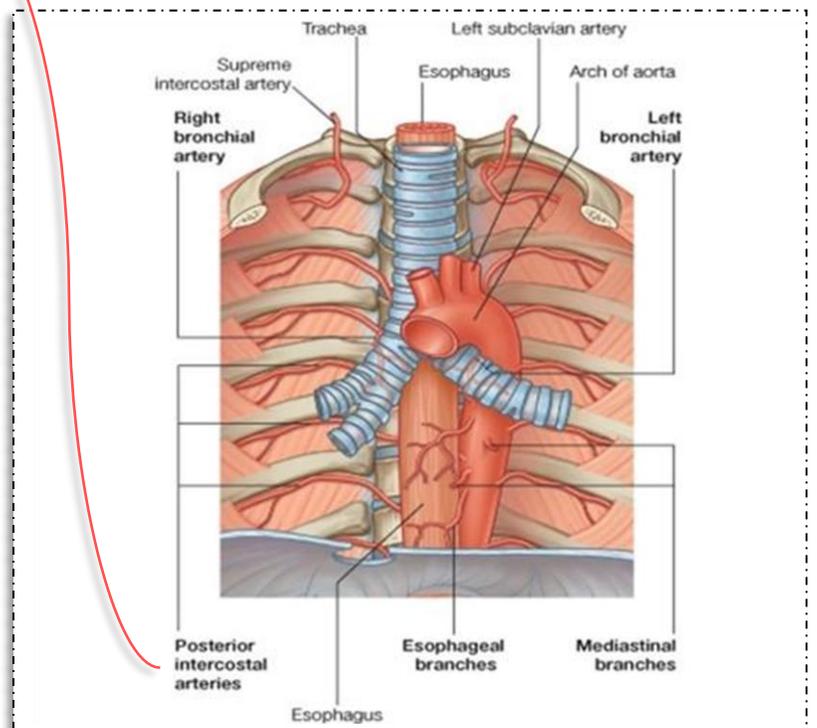
As it ascends in the thoracic cavity, it receives tributaries from the RIGHT posterior intercostal veins. Overall, it drains the upper lumbar region and the thoracic wall.

**Notice:** We have ONE azygos vein, and it is located to the right. (It is a unilateral vessel). The sentence in the slides says "azygos VEINS", I could not explain why, but perhaps it intended to say the azygos system of veins instead (because this system includes the azygos vein, hemiazygos vein...etc).

Ok, you should be familiar with our friend by now. Now, in order to see how it relates to the esophagus, look at the adjacent image, and see how it lies **posterior to the esophagus**. (Azygos vein is highlighted in green)

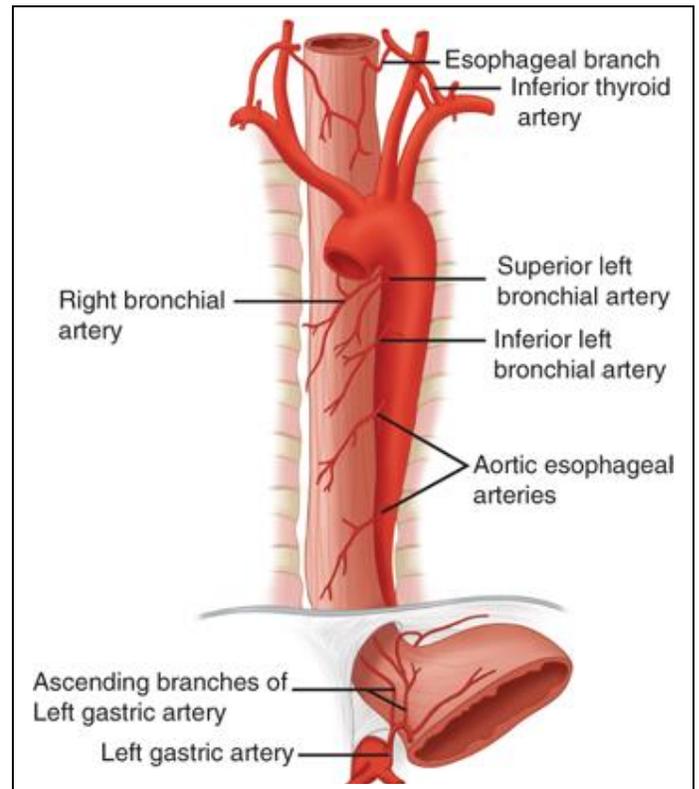


- **Right Posterior Intercostal Arteries:** These arteries originate from the thoracic aorta (with some exceptions). Look at the adjacent image, notice how the RIGHT posterior intercostal arteries originate from thoracic aorta, pass posterior to the esophagus and then continue their path along the ribs. By now you should have figured out why we said RIGHT only. The thoracic aorta (in the image shown) is still located to the left of the esophagus, so when the left posterior intercostal arteries emerge, they don't pass behind the esophagus, because the esophagus is on the other side (right)!



- **Descending thoracic aorta:** Wait, didn't we just say that the thoracic aorta lies to the left of the esophagus? Then Why is it among the posterior relations?

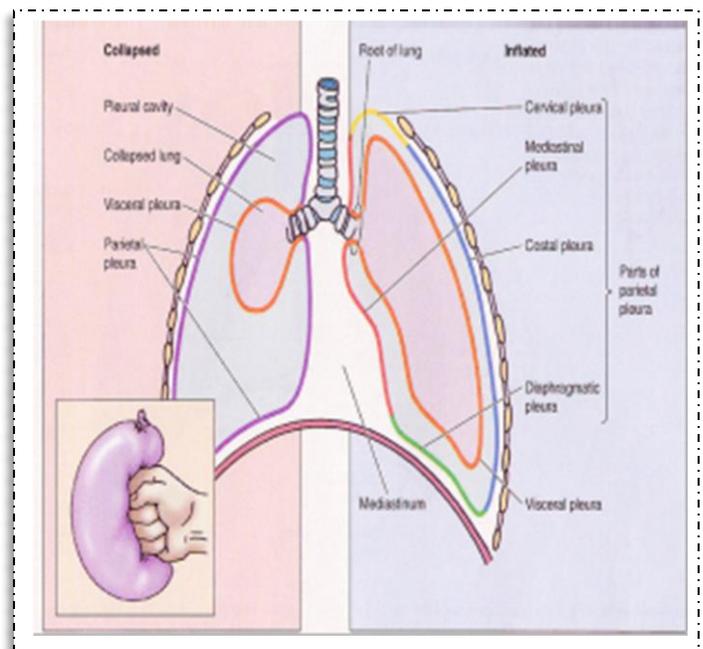
Well, the thoracic aorta is initially located to the left, but as it descends -and just above the diaphragm- it becomes posterior to the esophagus. This is why it is included in the posterior relations. The adjacent image should make everything clear. (Look at how the aorta curves backward).



**Slide 3: "Right side: The mediastinal pleura and the terminal part of the azygos vein"**

- To the right of the esophagus, you will find the **terminal part of the azygos vein**. Recall the azygos vein -as it ascends- lies posterior to the esophagus. The terminal part ,however, curves to the right to drain into the SVC. So, the terminal part can be found to the right of the esophagus. Refer to the image of the azygos vein to get a clearer picture.

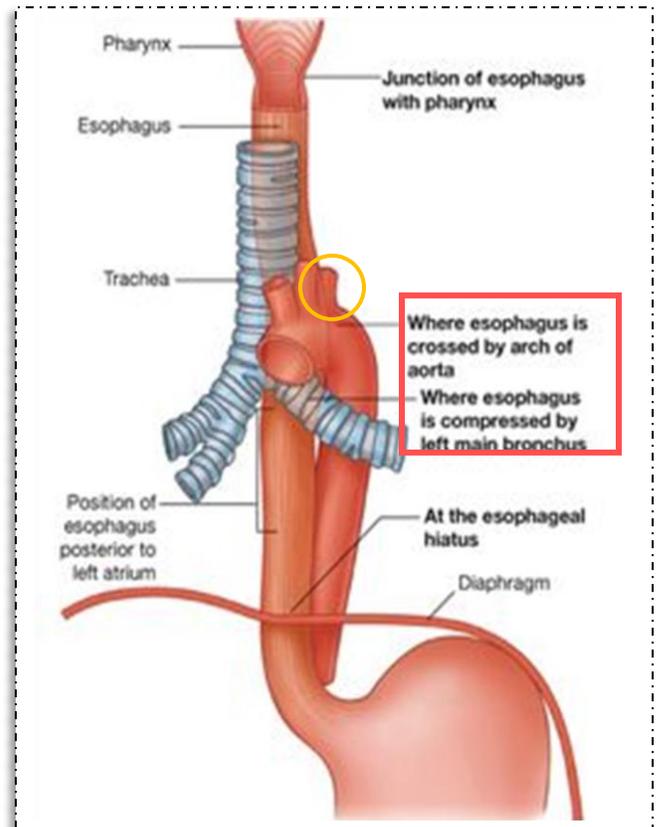
- **Mediastinal Pleura:** We know that the pleura is a serous membrane that lines the thoracic cavity (parietal pleura) and covers the lung (visceral pleura). The parietal pleura was divided according to the surface it faces: **Mediastinal pleura** (faces the mediastinum), **diaphragmatic pleura** (faces the diaphragm)...etc. We're currently interested in the mediastinal pleura. Since the esophagus passes through the mediastinum, we expect the mediastinal pleura to be related to both sides of the esophagus.



**Slide 3:** "Left side: The left subclavian artery, the aortic arch, the thoracic duct, and the mediastinal pleura"

✓ To the left of the esophagus, we find:

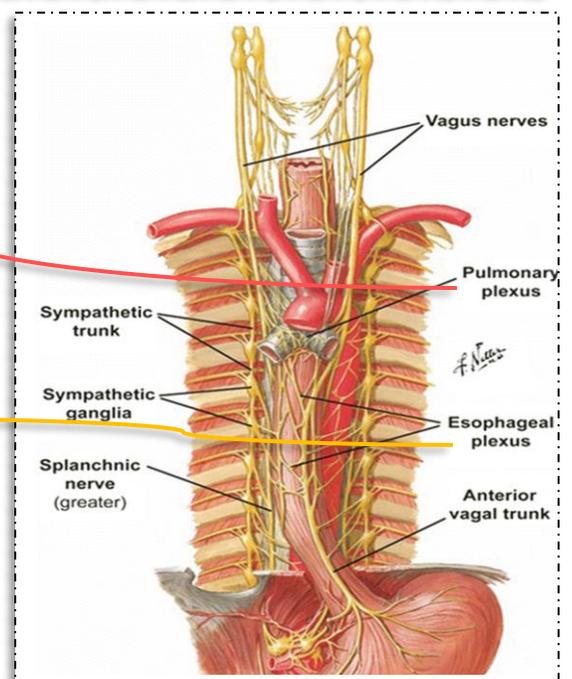
- **Left Subclavian Artery:** It emerges from the arch of the aorta (it is circled in yellow). It can be found during its path at the left side of the esophagus.  
Please read the notes in the red box in the adjacent image (they confirm what we discussed previously)
- **The thoracic duct:** If you refer to the image of the thoracic duct (which we discussed earlier), you will notice that after it passes posterior to the esophagus, it then curves to be located to the left side of the esophagus.
- **Mediastinal Pleura:** As we discussed in the previous section.



**Slide 4:** "Inferiorly to the level of the roots of the lungs, the vagus nerves leave the pulmonary plexus and join with sympathetic nerves to form the esophageal plexus"

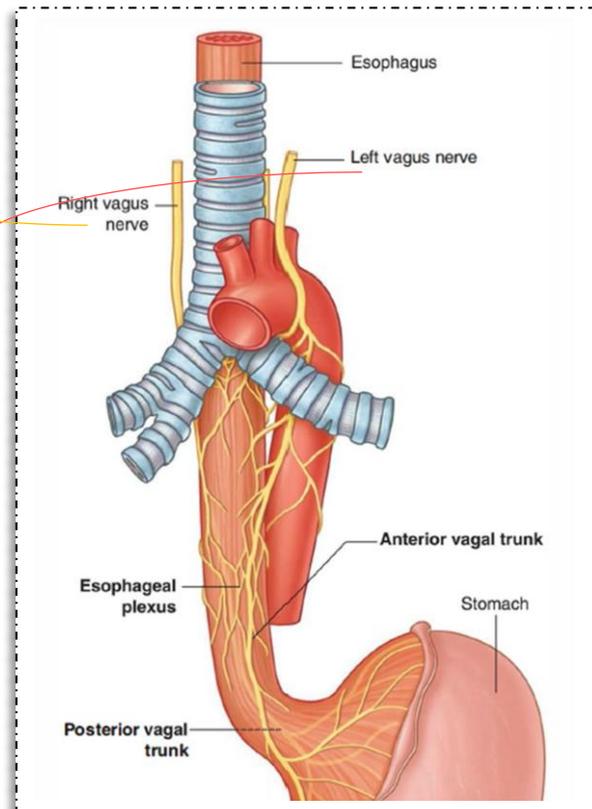
✓ Let's clarify what the pulmonary plexus is (without much focus on details):

**Pulmonary plexus:** "The **pulmonary plexus** is an autonomic **plexus** formed from **pulmonary** branches of vagus nerve and the sympathetic trunk". (Look at the adjacent image). The vagus nerve then leaves this plexus to join other branches from the sympathetic trunk and forms another plexus, the **esophageal plexus**. This plexus, as you can see, is directly related to the esophagus.



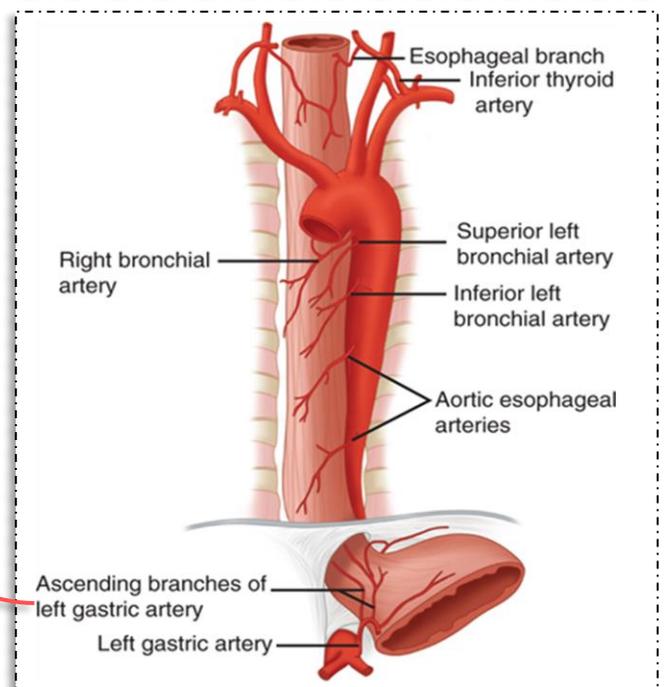
**Slide 4:** "The left vagus lies anterior to the esophagus and the right vagus lies posterior"

- ✓ This one is pretty straightforward. An image for clarification is all you need here.
- ✓ Notice how the **right vagus nerve** curves posteriorly and is now located behind the esophagus.
- ✓ The **left vagus nerve** curves anteriorly and is now located in front of the esophagus.
- ✓ The vagus nerves are very loyal friends of the esophagus, they continue to accompany the esophagus along its path, and they even enter the abdomen through the same opening, that's how loyal they are!



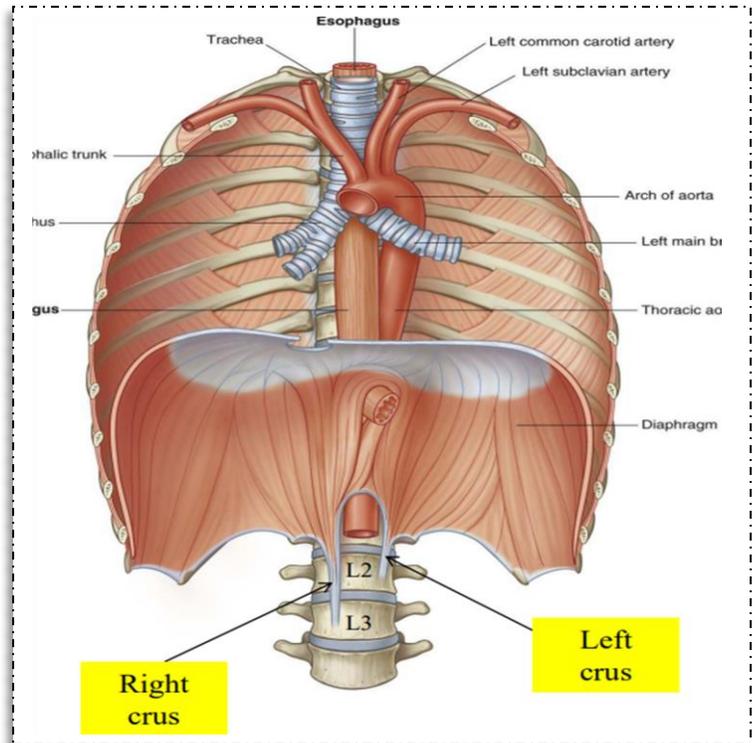
**Slide 4:** "At the opening in the diaphragm, the esophagus is accompanied by the two vagi, branches of the left gastric blood vessels, and lymphatic vessels"

- ✓ As the esophagus pierces the diaphragm, the two vagus nerves take advantage of this opening and enter the abdomen with the esophagus (loyal friends).
- ✓ **Left gastric blood vessels:** (Quick background: The gastric artery arises from the celiac artery, which is a branch from the abdominal aorta). Notice how branches of this artery are related to the esophagus. We also have a corresponding vein: **Left gastric vein** (not shown here).



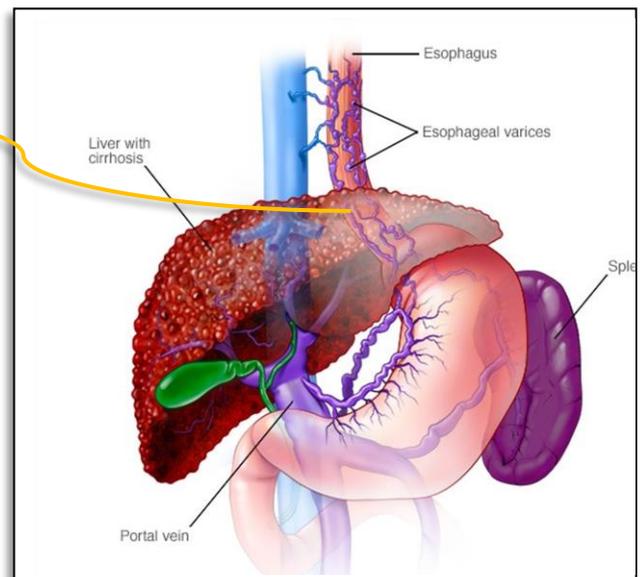
**Slide 4:** Fibers from the right crus of the diaphragm pass around the esophagus in the form of a sling. In the abdomen, the esophagus descends for about 0.5 in. (1.3 cm) and then enters the stomach

- ✓ This one brings back memories from the MSS course. Recall that the diaphragm is a muscle, and its muscle fibers originate from several different places. Some of its fibers arise from the lumbar vertebrae forming the **right and left crura** (singular: crus).
- ✓ Some of the fibers of the right crus ascend upwards and **surround the esophagus** (acts as a sphincter).



**Slide 4:** It is related to the left lobe of the liver anteriorly and to the left crus of the diaphragm posteriorly.

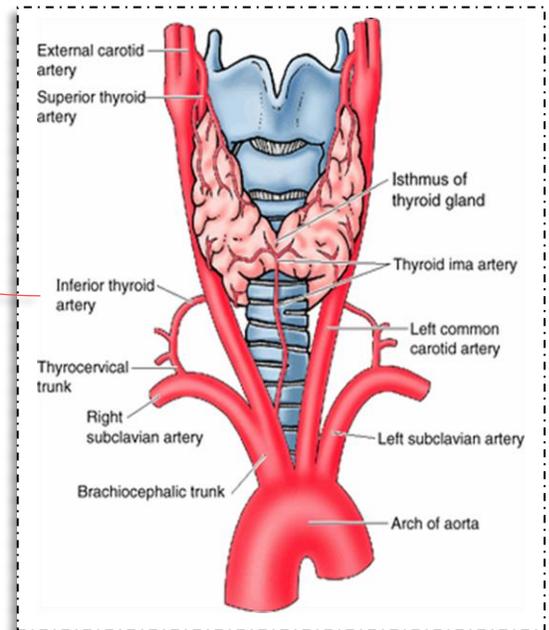
- ✓ Notice how the **left lobe of the liver** lies **anterior** to the esophagus.
- ✓ From the image in the previous section, you can see how the **left crus** is related to the diaphragm **posteriorly**.



## ❖ Blood Supply of the Esophagus

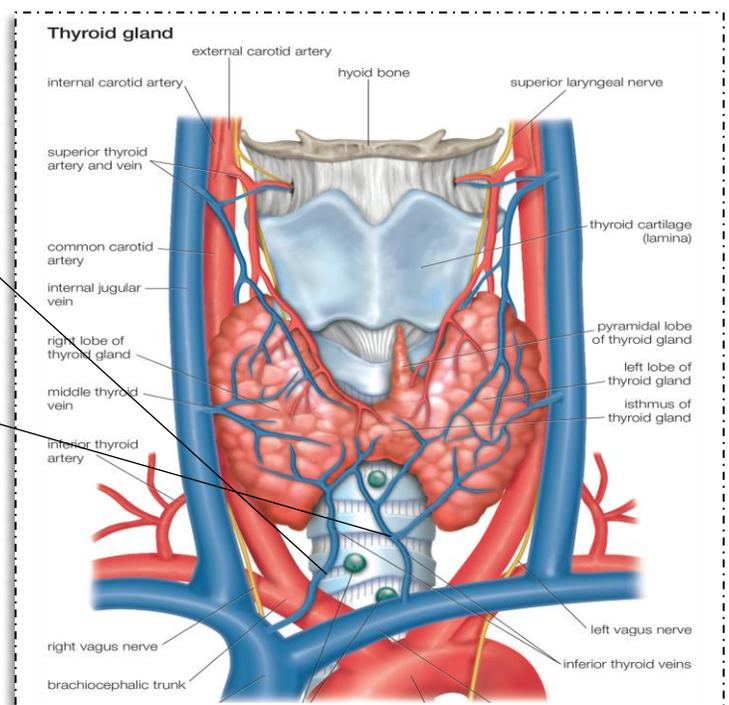
**Slide 5:** "The upper third of the esophagus is supplied by the inferior thyroid artery, ♦ the middle third by branches from the descending thoracic aorta, ♦ and the lower third by branches from the left gastric artery"

- **Inferior thyroid artery:** A branch from the thyrocervical trunk, which arises from the right subclavian artery. It supplies the **upper third of the esophagus**.
- **Branches from the descending aorta** supply the **middle third of the esophagus**.
- **The left gastric artery** (the one we discussed 2 pages ago) supplies the **lower third of the esophagus**.

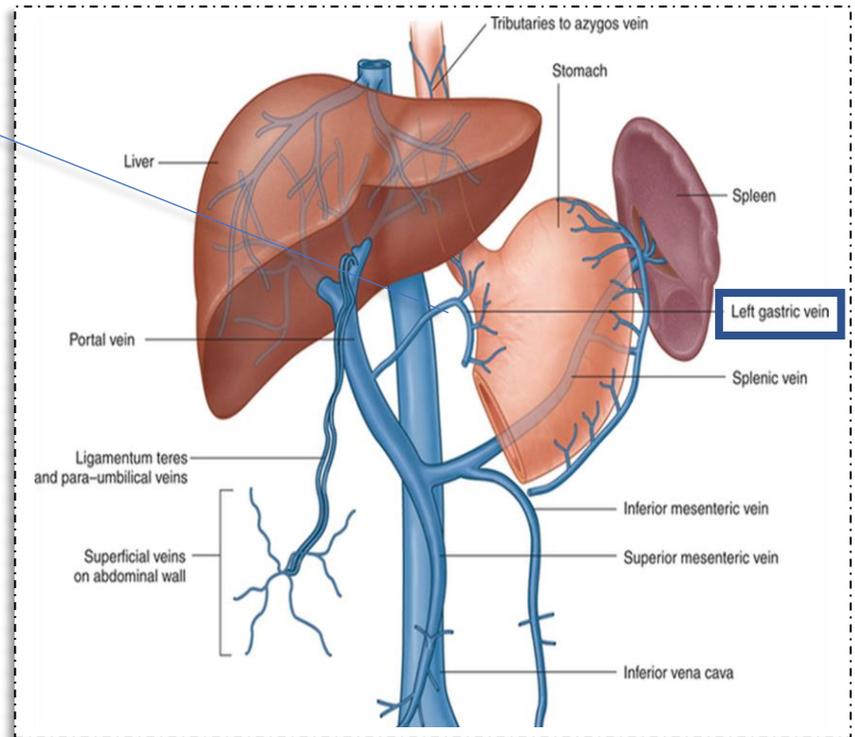


**Slide 5:** The veins from the upper third drain into the inferior thyroid veins, from the middle third into the azygos veins, and from the lower third into the left gastric vein, a tributary of the portal vein.

- **Inferior thyroid veins:** These veins can be seen in the area roughly around and below the thyroid gland. The **right and left inferior thyroid veins** drain into the right and left brachiocephalic veins, respectively, near their junctions with the SVC. They drain the **upper third of the esophagus**.
- **The azygos veins** drain the **middle third of the esophagus**. (Refer to earlier images to see the azygos vein again)

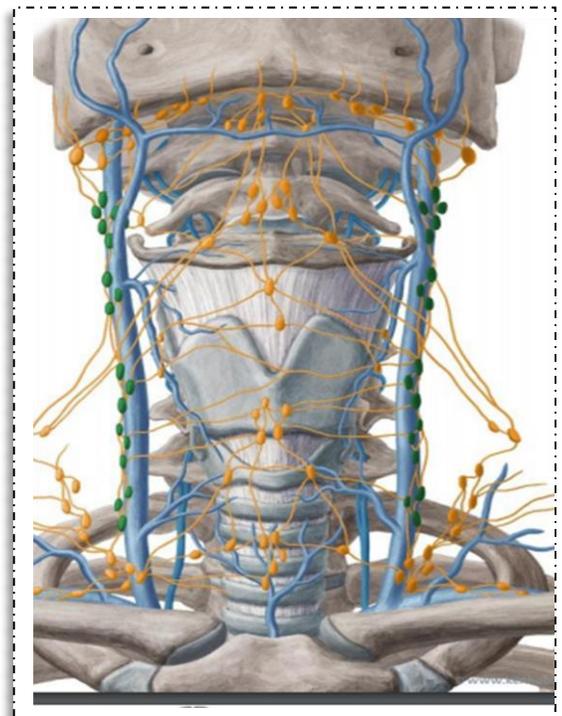


- **Left gastric vein:** We talked about this vein earlier. It drains the **lower third of the esophagus**, and then drains into the portal vein.

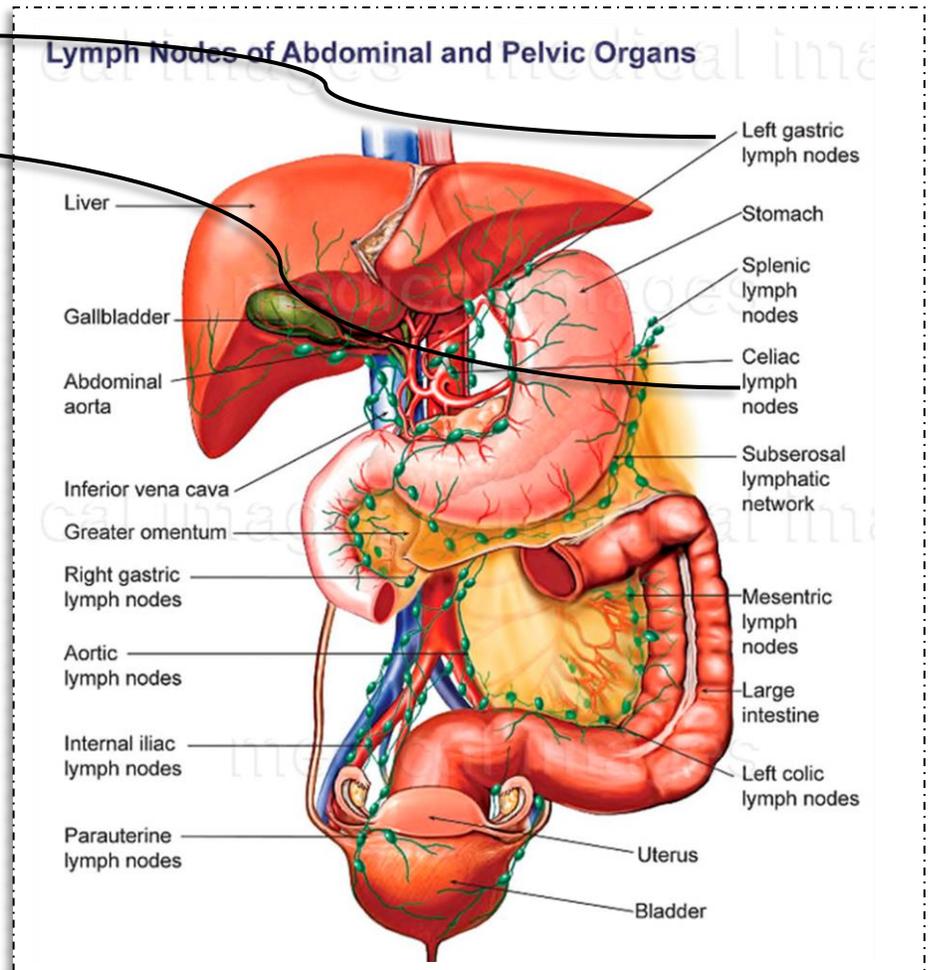


**Slide 6:** Lymph vessels from the upper third of the esophagus drain into the deep cervical nodes, ♦ from the middle third into the superior and posterior mediastinal nodes, ♦ and from the lower third into nodes along the left gastric blood vessels and the celiac nodes

- Nothing much to say here. All you need are some images to be able to imagine the locations of the different lymph nodes, and which parts of the esophagus they drain.
- **Deep cervical lymph nodes:** drain the **upper third of the esophagus**. (In the adjacent image, they are highlighted in green along the IJV (lateral group), and the yellow ones along the midline (median group)).
- **Superior and posterior mediastinal lymph nodes:** drain the **middle third of the esophagus**. (knowing their names should be sufficient for now).



- Lymph nodes along the gastric blood vessels and the celiac nodes: drain the lower third of the esophagus.



Slide 6: The esophagus is supplied by parasympathetic and sympathetic efferent and afferent fibers via the vagi and sympathetic trunks ♦ In the lower part of its thoracic course, the esophagus is surrounded by the esophageal nerve plexus.

- Very straightforward information.
- Note: Esophageal plexus was discussed previously. Refer to image

*Good Luck!*