

# CARDIO-VASCULAR SYSTEM

3



## Pathology

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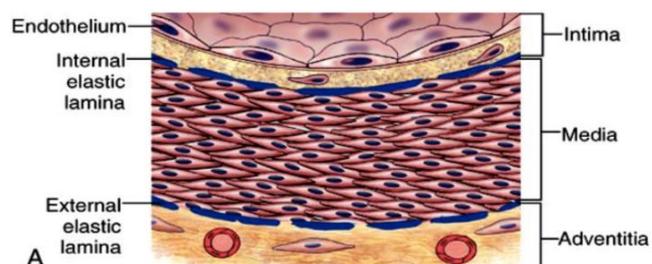
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# Veins and lymphatics

## Quick recap: -

As we have learned before in histology, there are three layers within the wall of any blood vessel: **tunica intima**, **tunica media** and **tunica adventitia**.



The intima is composed of endothelial cells, and Beneath these cells, a delicate connective tissue that is bordered by internal elastic lamina is present.

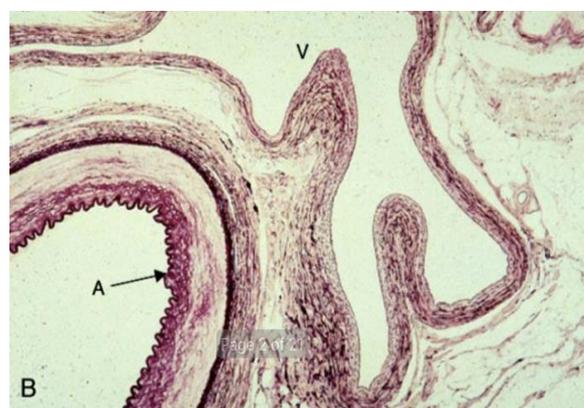
The second layer is the media, which is mainly composed of smooth muscle fibers, and in some particular type of blood vessels, we have elastic fibers as well. It is bounded by external elastic lamina.

And then we have the adventitia where we have connective tissue, fibroblast and some smaller sized blood vessels that give nourishment to the blood vessel wall. These are called **vasa vasorum**

This microscopic picture shows us an artery and an adjacent vein (notice that part A represents the artery, while part V represents the vein)

As you can notice, we have certain differences between them. Arteries have thicker walls; they look more rounded and more rigid. On the other hand, veins are characterized by having thin walls that don't have well-developed media. They also have low intraluminal pressure, that's why it's easy to compress veins and change its shape.

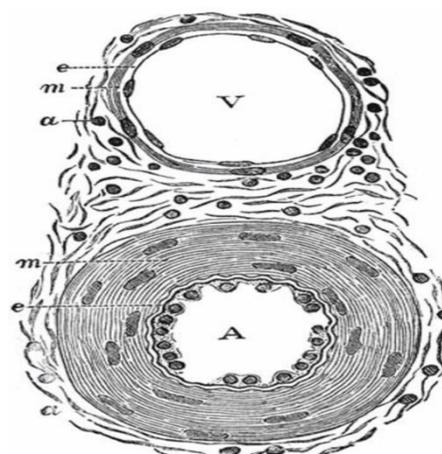
So, arteries look like rigid pipes and veins tend to be collapsed.



ARTERY (A) VERSUS VEIN (V)

Another diagram for the comparison between the structure of an artery and vein shows the following:

- The point of similarity between arteries and veins is the presence of the three different layers within their walls.
- The major difference is the media layer, which is much thicker in arteries and stronger than that in veins.

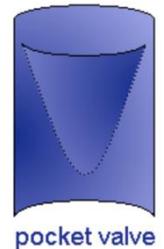


Now, after finishing the revision, we can start our lecture about the pathology of veins and lymphatics.

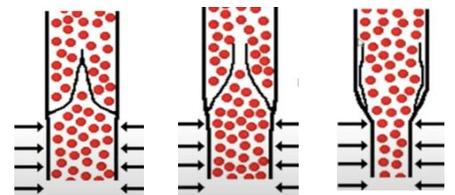
## Normal vein physiology: -

before we dive into the pathologies of veins, we need to understand what a normal vein physiology is.

veins in general, especially large veins of the lower limbs, contain structures from inside that are called **pocket valve**. These valves are found inside the veins and they help in its function to return the blood from tissues back toward the heart within the venous blood flow.



So, as you can see, these pocket valves work as unidirectional valves allowing the blood to move in one direction outside the tissue and toward the heart. The arrows in the figure represent the function of the surrounding skeletal muscles, which help the veins in maintaining its normal physiological function, and this effect is called **squeezing effect**.



Now if there is something wrong with these valves or skeletal muscles, for example, congenitally abnormal pocket valves or weakness in the surrounding skeletal muscle for some reason or even an increase in the intraluminal pressure within these veins for any reason. All these abnormalities may lead to a pathological process called **varicose veins**, which is our first topic in veins pathology.

## Veins pathology

### 1- Varicose veins: -

They are abnormally dilated, tortuous veins that appear due to a prolonged increase in intra-luminal pressure and loss of vessel wall support. The most common location of those varicose veins is the superficial veins of the legs, this is where they are most commonly seen .

This is a picture of a patient's leg before and after two hours of standing. as you can notice the main difference is the presence of tortuous and dilated bluish vessels under the skin, which are the varicose veins.



After prolonged standing

Before

### - **Symptoms:** -

Symptoms vary from one patient to another and can vary according to the location and the severity of the condition, and they include: **venous stasis, edema** of the affected limb (simple orthostatic edema) and of course **the cosmetic effect** of this problem, which is a major complaint in some patients.

“Varicose veins” is quite common, it can affect 10% to 20% of adult males and more than 30% of adult females.

### - **Risk factors:** -

Risk factors for lower limb varicose veins include: **Obesity, Female gender, pregnancy, and Familial tendency** (some families are known to develop premature varicosities because of the imperfect venous wall development)

### - **Microscopic Morphology:** -

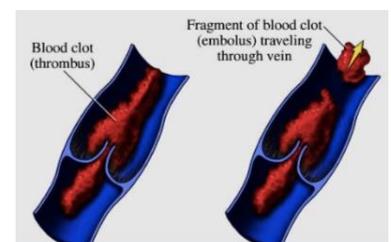
If we take a vein that is involved in varicosities and look at it under the microscope, we might see the following findings: **Vein wall thinning, intimal fibrosis in adjacent segments**, we can also see some **spotty medial calcifications** (phlebosclerosis), sometimes these varicosities might develop **Focal intraluminal thrombosis**, and in cases where there are some congenital components of the problem, we might see **venous valve deformities** like (rolling and shortening)

### - **Complications:** -

1. **stasis, congestion, edema, pain, and thrombosis**
2. **chronic varicose ulcers** which is the development of skin ulcers overlying the site of varicosities, this is usually present in patients with other vascular problems and those who suffer from varicose veins for prolonged periods of time
3. **embolism is very rare**, so it's not a major problem in superficial veins that develop varicosities.

## 2- **THROMBOPHLEBITIS & PHLEBOTHROMBOSIS:** -

Another important condition that affects veins, both terms are interchangeably used as they mean the same thing. **Phlebothrombosis** means **formation of thrombus** inside the **vein**. **thrombophlebitis** means **thrombosis** and **inflammation** in the **venous** wall. So, we have two processes that happen inside the vein, inflammation and thrombus formation. Which process happens first? some people say that thrombosis starts first, and this thrombosis will lead to the inflammation of the wall, while others say that inflammation is the trigger that leads to thrombus formation.

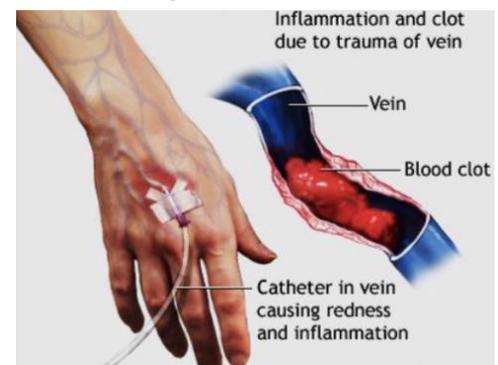


This condition is quite common and the most common site affected is the deep leg veins, more than **90%** of all cases are seen within the deep leg veins.

**Predisposing factors** for thrombophlebitis include: **congestive heart failure, neoplasia, pregnancy, obesity, the postoperative state, and prolonged bed rest or immobilization.** As you can see, all of these factors were discussed when we talked about risk factors for blood stasis. So, anything that leads to abnormal blood flow especially in the venous circulation might act as a risk factor for development of thrombophlebitis.

- **Clinical manifestations** are variable and include local as well as systematic manifestations. The Local manifestations of thrombophlebitis include: **distal edema** ( distal to the site of occlusion), **cyanosis** of the affected limb, **superficial vein dilation** because of the backflow of blood towards those veins, the feeling of **heat, tenderness,** the presence of **redness, swelling, and pain.**

Thrombophlebitis of upper limb veins is not common, and when present, it usually gets associated with some local risk factors like use of **catheter** or **canula.** In rare cases, it can be associated with **systemic hypercoagulabilities syndromes.**



Now, we are going to discuss some information about special types of thrombophlebitis, these syndromes are important because they might be a mark for an underlying significant disease.

### **Special thrombophlebitis types:**

#### **a- Migratory thrombophlebitis (Trousseau sign):**

In this condition, the patient develops hypercoagulability because of an underlying tumor, so this is a paraneoplastic syndrome that is related to a tumor that elaborates pro- coagulant factors.

So the patient is having some sort of cancer (e.g. colon cancer, pancreatic or stomach cancer) and this cancer as a paraneoplastic syndrome releases into the circulation a substance that works as a procoagulant factor, and this will lead to **migratory thrombophlebitis**, which means the patient will develop multiple areas of thrombophlebitis involving his extremities, abdomen or internal organ and these thrombophlebitis events will have a migratory pattern of occurrence (there will be some time laps between the attacks).

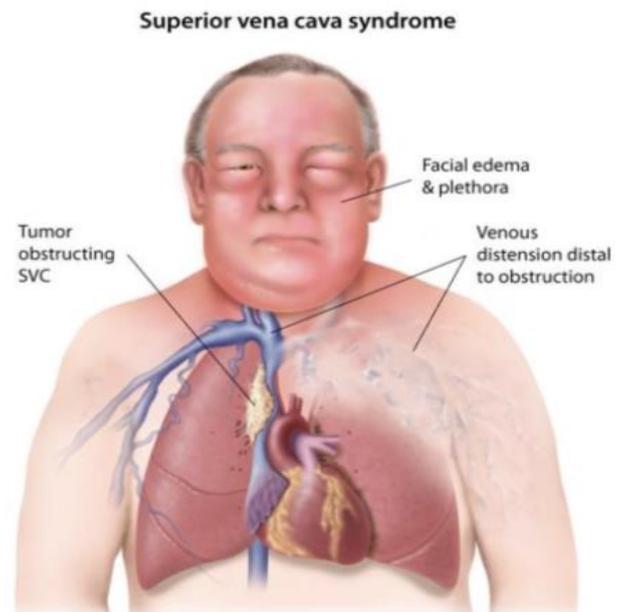


## b- The superior vena caval syndrome:

As we know, superior vena cava receives the venous blood back from the head, neck, upper limbs and upper part of the chest, and returns it into the heart.

This syndrome is usually caused by neoplasms that either compress or invade the superior vena cava. **Most common cancers that can produce this disease is lung cancer.** The syndrome will manifest by marked dilation of the veins of head, neck and arms with cyanosis.

As we can see in the picture, this patient, who has a lung tumor that is obstructing his superior vena cava leading to backflow of venous blood towards the organs that were drained by the SVC, which are the head, neck, shoulders, upper limb and upper chest.



So, the patient will complain from facial edema, plethora, congestion and distention of the veins distal to the obstructions.

## c- The inferior vena caval syndrome:

Caused by neoplasms that either compress or invade the inferior vena cava. **Most common neoplasms producing this disease are hepatocellular carcinoma** coming from the liver or **renal cell carcinoma** within the kidney. These tumors are known for having a striking tendency to grow within veins.

The patient will develop marked lower extremity edema, distention of the superficial collateral veins of the lower abdomen (medusa).



Now After finishing veins pathology, we move into our final topic in this sheet, lymphatics pathology. We will very briefly discuss lymphedema, lymphangitis and chylous.

# Pathology of Lymphatics

## 1- Lymphedema: -

The presence of edema as a result of lymph obstruction.

As we all know, the lymphatics in our body help to return part of the interstitial fluid from tissues back into the venous blood and from there it will be back to the heart. So, one of its functions is to return extra fluid and help in the venous return to the heart.

Now, if for some reason one of those lymphatics is obstructed this means that the interstitial fluid will accumulate within the tissues distal to the site of the blockage. With time this will lead to swelling and inflammation of the tissues below the level of the obstruction leading to the formation of lymph edema.

Lymphedema can occur as either primary or secondary lymphedema.

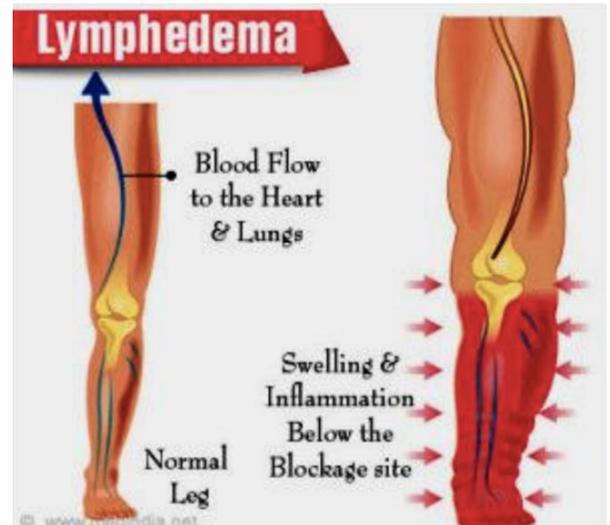
### a- Primary lymphedema: -

It's usually congenital in pathogenesis and is usually the result of **lymphatic agenesis** (lymphatics in certain parts of the body are completely absent) or **hypoplasia** (underdeveloped). It usually manifests early in life during childhood.

### b- Secondary lymphedema: -

Much more common than primary lymphedema. It's usually obstructive in nature meaning that there is some sort of blockage in a previously normal lymphatic vessel. Example on causes that might lead to secondary lymphedema include: **Malignant tumors, Surgical procedures removing lymph nodes** for example the surgical procedure that is used to treat breast cancer, which include removal of the tumor and breast tissue in addition to ipsilateral axillary lymph node, **Post-irradiation, Fibrosis** at the site of the affected lymphatic, **Filariasis** which is a parasitic infection that leads to inflammation, destruction and occlusion of the lymphatic vessels within the affected limb, also anything that leads to inflammation of the associated **Post inflammatory thrombosis and scarring** at the site of the previous inflammation.

This is a picture showing lymphedema, you can see the difference between the normal limb and the abnormal limb affected by lymphedema. As you can see the huge distention and swelling of the affected limb.



## 2- LYMPHANGITIS: -

This word contains the suffix **ITIS** which means inflammation, **ANG** means vessel, so this refers to inflammation of the lymphatic vessel. Almost always this inflammation is related to infection by a bacterial microorganism that spreads into lymphatics, most commonly **group A  $\beta$ -hemolytic streptococci**.

Because of the inflammation, the affected lymphatic will become dilated and filled with an **exudate** of neutrophils and monocytes. The affected site would show redness and painful subcutaneous streaks, which represent the inflamed lymphatics. This might be also associated with painful enlargement and swelling of the draining lymph nodes. This is known as acute lymphadenitis.

Rarely, subsequent passage of this inflammation into the venous circulation can result in bacteremia or sepsis especially in immunocompromised patients.



## 3- CHYLOUS: -

Milky accumulations of lymph in various body cavities. So, in this condition the accumulation of lymph doesn't happen within the interstitial spaces of tissues, it happens within the body cavities. We have three body cavities that might develop lymphatic accumulation: **The pleural cavity, the pericardium and the peritoneum**. The most important mechanism of development of chylous is rupture of dilated lymphatics, that are typically obstructed secondary to an infiltrating tumor mass.

### Types of chylous: -

Depending on the location of chylous accumulation, we either have **chylous ascites**, where accumulation happens within the peritoneal cavity (abdomen), or **Chylothorax**, where accumulation happens within the pleural cavity (chest), or **Chylopericardium**, where the chylous accumulate within the pericardium.

The word chylous comes from the milky appearance color and consistency of the accumulated fluid.



**IF NOT NOW THEN WHEN**



The End