



VENOUS & LYMPH

circulation



APRIL 21, 2019

اعداد
لجنة التبييض

Venous circulation

The circulatory system may be divided into:

(1) Low pressure side.

- 1- Venous vessels.
- 2- Rt. side of the heart
- 3- pulmonary circulation
- 4- Left side of the heart during diastole

(1) high pressure side.

- 1- Left ventricle during systole
- 2- Arteries
- 3- Arterioles.
- 4- Capillaries.

Note:

- **Right ventricle:** has a thin wall thus doesn't have high pumping power
- **Left ventricle:** has a thick wall and a strong pumping power
- **Pulmonary circulation:** start at the right atrium → right ventricle → pulmonary arteries → lungs → ends at left atrium.
- **The left ventricle aid:** a process in which the left ventricle and the interventricular septum contraction aid the action of the right ventricle

Veins are thin-walled-non-pulsatile vessels which can be highly distended and collapse; they are supplied by sympathetic fibers. They are affected by chemical substances that affect arteriolar diameter.

❖ Functions of the veins:-

(1) Veins as transport vessels

- Veins conduct blood from tissues to the heart **with minimal energy loss** as they offer little resistance to blood flow.
- The pressure in the veins in the recumbent position is 10 mmHg, and zero mmHg in the right auricle- Thus the drop of pressure is 10 mmHg.

Note: - The right auricle is located in the right atrium

- In recumbent position we negate the affect of gravity on the blood column so the blood return to the right atrium with a pressure drop of 10 mm

(2) Veins as a capacitance vessels

- The capacity of the venous system is 200 times greater than the capacity of the arterial system.
- So, veins can accommodate large volume of blood with mild increase in pressure.
- So, veins are called capacitance vessel.

N.B: Capacitance = $\frac{\Delta V}{\Delta P}$

Note: If the veins are severely dilated it can contain all the blood → no venous return (the blood will pull in the veins and it will not move)

Central venous pressure (CVP)

It is the pressure in the right atrium and big vessels connect to it

It is = 0-5 mmHg

It is increased with hypervolemia and decreased with hypovolemia

Note: Hypovolemia has many causes such as hypovolemic shock, diarrhea and severe blood loss

(Mean Circulatory Pressure)

It is the mean pressure in the vascular system when the blood stop flowing, it is about 7-8 mmHg.

Its level is controlled by the relation between the blood volume and the capacity of the cardiovascular system

Note:

- Mean circulatory pressure = Mean systemic pressure
- It is measured when there is no blood flow in the blood vessels
- It is an indicator of how full the circulation is (i.e. the volume of blood in the system compared to the capacity of the system)

❖ Factors affecting venous return:-

1- Venomotor tone

- The veins receive sympathetic V.C fibers which discharge continuously to the veins giving the venomotor tone.

- That is sufficient to make the veins in the lower limbs rigid enough to prevent over pooling of blood when the person changes his position from supine to erect position.
- If the venomotor tone is decreased, the blood pools and orthostatic hypotension occurs

Note: the vasoconstriction center (V.C.C) has a basal tune to prevent the severe dilatation of the blood vessels and prevent blood pool in the veins

2- Muscle activity and venous valves (Muscle pump)

- The veins in lower limbs are surrounded by skeletal muscles, when these muscles contract as in walking; they squeeze the veins and push the blood toward the heart.
- As the veins contain valves, they allow the flow of blood in one direction only toward the heart and the blood does not return back.
- The valves also reduce the effect of gravity.
- In condition of **varicose veins, the valves become incompetent, so the flow of blood toward the heart is decreased.**

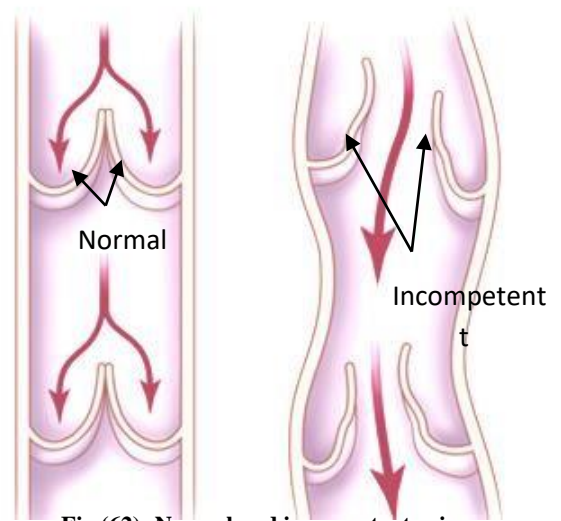


Fig.(62): Normal and incompetent veins

Note:

- The blood in the veins of varicose veins patient, especially in the lower limbs, pools → thus the vein swells and got a tortuous route → due to increase of blood volume inside it
- Varicose veins patients shouldn't stand for a long time to prevent the pool of more blood in the lower limbs. Also, they should do exercise to increase the action of the muscular pumps. Moreover, they should have a normal bodyweight and a good diet.
- One of the surgical treatments of varicose veins is by blocking the superficial veins thus the blood wont pool in them (the venous return will be carried out through deep veins)

3- Respiratory movements (Thoracic pump)

- During inspiration, CVP drops from 6 to 2 mmHg aiding V.R.
- Also, during inspiration, the diaphragm descends & intrabdominal pressure rises, pushing blood toward the heart.

Note: During inspiration the intrathoracic pressure decreases thus aid in venous return.

Lymphatic Circulation.

As the filtration at the arteriolar end of the capillaries is greater than that at the venular end, the excess fluids in the interstitial tissue spaces are drained by the lymphatic vessels that drain almost tissues of the body except the C.N.S and bones.

The fluid drained is called the lymph and it is transported through the lymph vessels, which are blind vessels called lymph capillaries. **These lymph capillaries unit together to form large vessels which finally end by two trunks.**

1-The thoracic duct.

It drains the lymph from the lower limbs, abdomen, left arm, left half of the thorax, and left side of the head and neck. It opens in the venous system at the junction of **the left subclavian and internal jugular vein.**

2-The right lymph duct.

It drain the lymph from the right arm, right half of the thorax, right side of the head and neck, it opens into the venous system at the junction of **right subclavian vein** and internal jugular vein.

Lymph Nodes.

These are collections of reticuloendothelial cells along the course of the lymphatic vessels.

Note:

- Macro proteins sometimes cannot diffuse through the capillaries walls thus they defuse through the lymph capillaries that's why many proteins are found in the lymph
- The lymph also carries debris such as puss or microbes because of that lymph must cross over lymph nodes in order to eliminate the microbes and pathogens
- The spleen is the largest lymph node in our body

Structure of lymph capillaries.

They have no basement membrane and wide fenestrations.

Its permeability is much more than the blood capillaries.

The large lymphatic vessels have valves that allow the unidirectional flow of lymph.

Functions of lymphatic system.

1-It drains the excess amount of fluids filtered at the arteriolar end of the capillaries back to the circulatory system.

2-The lymphatic system is considered as a part of the reticuloendothelial system that shares **in the defensive mechanisms of the body.**

3-It carry the large molecules that are collected in the interstitial tissue spaces by cytopemesis and prevent its collection, as its collection leads to increased osmotic pressure of the fluids in the interstitial tissue spaces leading to accumulation of fluids and edema occurs.

Lymph flow.

The lymph flow is about 4 liters /day and its rate of flow is increased in all conditions that increase the rate of flow from the capillaries.

Composition of lymph.

1-It is colorless isotonic fluid, its pH is 7.4

2-It becomes milky after fat absorption due to the presence of fat globules. (Fat = such as chylomicrons which are full of lipids(fat))

3-Its structure is similar to plasma except that the lymph protein is 2 gm/dl

4-It contain small number of lymphocytes, prothrombin, and fibrinogen

5-It contain no platelets and small amount of calcium so it clots slowly.

Factors which maintain lymph flow.

1-Skeletal muscle contraction increases the lymph flow as it compresses over the lymph vessels.

2-Lymph flow is increased by contraction of the plain muscles in the wall of lymphatic vessels.

3-Valves in the lymph vessels allow the lymph to flow in one direction

4-The negative intrathoracic pressure sucks the lymph toward the thorax.

5-Respiratory movements: during inspiration the intrathoracic pressure becomes more negative and the lymph flow toward the thorax is increased.