

Done by:-

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## PART EIGHT: CIRCULATORY SYSTEM

هذه المذكرة عبارة عن سلايدات الدكتور مضافا اليها نوتات الطلاب (بالمربع الازرق)

## Objectives of the lecture:-

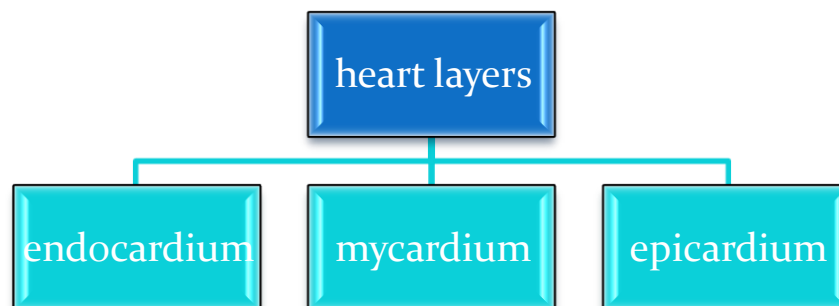
Microscopic structure of:

- 1- Wall of the heart & heart valves.
- 2- Wall of the blood vessels:
  - a. Elastic arteries.
  - b. Muscular (medium-sized) arteries.
  - c. Blood capillaries.
  - d. Medium-sized veins.

## Outlines:-

- ✓ Heart
- ✓ Blood vessels
- ✓ Arteries:
  - Elastic arteries.
  - Muscular (distributing) (medium-sized) arteries.
- ✓ Blood capillaries.
- ✓ Veins:
  - Medium-sized veins.

## Heart



## Endocardium:- “Endo = inside” “cardium = heart”

- 1- **Endothelium:** simple squamous epithelium.
- 2- **Subendothelial:** layer Connective tissue contains fibro-elastic Connective tissue
- 3- **Dense\_C.T. layer**
- 4- **Subendocardial layer:** Loose Connective tissue layer that contains Purkinje fibers small blood vessels & nerves. It attaches to the endomysium of the cardiac muscle

**Notes:-**

**Endothelium** in contact with blood, nutrients transport by passive diffusion, so no blood vessels

**Subendocardial** forming the boundary between endocardium and myocardium

**Myocardium:-** "myo= muscle that it contain muscle cells"

It is the middle layer

It is the most thick layer

It contains cardiac muscle cells with endomysium (loose connective tissue)

**Epicardium:-**

It is the visceral layer of pericardium

**Mesothelium:** simple squamous epithelium.

**Subepicardial connective tissue:** Loose connective tissue. contains the coronary vessels, nerves, ganglia & fat cells.

**Notes:-**

**Endothelium:** is specialized type of simple squamous epithelium that lines the interior surface of blood vessels.

**Found in:**

- 1- blood vessels
- 2- endocardium ( chambers of heart )
- 3- lymph vessels

**Mesothelium:** simple squamous epithelium derived from mesoderm, that covers the surface of all true serous membranes.

**Found in:**

- 1- pericardial cavity
- 2- peritoneal cavity
- 3- pleural cavity

**Submesothelium:** It is continuous with the parietal layer enclosing the pericardial cavity, which is filled with fluid.

**Heart valves:-**

Each leaflet (cusp) of heart valve is formed of:

**1- A core of Dense irregular Connective tissue** : extends from the fibrous skeleton of the heart.

2- This core is covered by: **Endocardium**

- The leaflets of the heart valves are normally avascular.
- Blood capillaries and smooth muscle cells can be found only in the base (the root) of the leaflet.

## Blood vessels:-

- It is composed of 3 concentric layers:

**1. Tunica Intima** (T.I.): “the innermost layer”

- It is composed of:

**a- Endothelium**: simple squamous endothelial cells (single flattened endothelial cells).

**b- Subendothelial connective tissue layer**: it is composed of loose connective tissue

**c- Internal elastic lamina**: Well-developed in muscular arteries and its composed of fenestrated elastic sheet.

**2. Tunica Media** (T.M.): “the intermediate layer”

- It is composed of:

1- Smooth muscle cells: helically-arranged.

2- Elastic fibers or fenestrated elastic sheets (or membranes).

3- Reticular fibers (type III collagen).

4- Collagen fibers (type I collagen).

5- External elastic lamina: separates T. media from T. adventitia. It consists of several layers of thin fenestrated elastic sheets.

**N.B.** both blood capillaries and postcapillary venules do not have a tunica media where pericytes replace the T.M.

**Tunica Adventitia** (T.A.): “outermost layer”

\* It is composed of loose fibroelastic connective tissue.:

- Fibroblasts.

- Type I collagen fibers. “Produced by fibroblasts”

- Elastic fibers. “Produced by fibroblasts”

**. Vasa vasorum:**

- are small arteries in tunica adventitia and the outer part of tunica media.

- They are more prevalent in the walls of veins than arteries – why?
- Venous blood contains less oxygen and nutrients than arterial blood.

### Notes:-

**Generally, arteries have thicker walls and smaller lumens than veins.**

**Internal elastic lamina separates tunica intima from tunica media**

**Vasa vasorum: ( not present in capillaries )**

**Tunica media and adventitia of large arteries and veins Can't get nutrients by diffusion and are nourished by the vasa vasorum, which are small arteries that enter the walls of blood vessels.**

## Blood Arteries:-

### A- Elastic arteries:-

- Examples: aorta, common carotid a., subclavian a., common iliac aa, pulmonary Trunk.

\* Microscopic structure:

#### 1- T. Intima.:

- Endothelium.
- Subendothelial C.T.
- Internal elastic lamina: (not prominent)

#### 2- T. Media.:

consists of :-

A- Fenestrated elastic membranes (sheets) (lamellae):

- The main component of T.M.

B- In between, there are:

1- Smooth muscle cells: are less abundant & secrete all other components in T.M.

2- Collagen fibers (type I collagen).

3- Reticular fibers (type III collagen).

4- Elastic fibers.

c- External elastic lamina

#### 3 - T. Adventitia.:

- Much thinner than T.M.
- It is composed of loose fibroblastic C.T.
- Contains vasa vasorum → send branches to the outer part of T.M.

**B- Muscular arteries** “also its call (Medium-sized arteries or Distributing arteries):

- **Examples:** brachial, ulnar, renal.

- Microscopic structure:

**1- T. Intima.:**

- Endothelium.

- Subendothelial C.T. layer.

- Internal elastic lamina:

\* Is prominent.

\* Displays an undulating surface.

\* Occasionally it is duplicated (bifid internal elastic lamina).

**2- T. Media.:**

**A.** Smooth muscle cells: are the predominant component.

**B.** In between there are:

- Elastic fibers.

- Type III collagen fibers.

- Type I collagen fibers.

**C.** External elastic lamina: may be identifiable.

**3- T. Adventitia.:** loose fibroelastic C.T.

## Blood Capillaries:-

- Diameter: 8-10  $\mu\text{m}$  and Length:  $\sim 50 \mu\text{m}$ .

- Microscopic structure:

**1- Single layer:** of squamous endothelial cells.

**2- Basal lamina:** surrounds the external surface of the endothelial cells.

**3- Pericytes:** Have processes and share the basal lamina of the endothelial cells.

### Types of blood capillaries :

**1- Continuous blood capillaries :**

Microscopic structure and No pores or fenestrae in their walls.

- **Distribution:** In muscles, nervous T., C.T.

**2- Fenestrated blood capillaries:**

**a-** Fenestrated Blood Capillaries with Diaphragms :

Microscopic structure:

- Their walls have pores (fenestrae).

- These pores are covered by a pore diaphragm.

Distribution:

- In intestine, pancreas and endocrine glands.

**b-** without diaphragms :

Distribution: In renal glomerulus.

**3- Sinusoidal blood capillaries :**

- Diameter: 30-40  $\mu\text{m}$ .
- Microscopic features:
  - \* They possess many large fenestrae without diaphragms.
  - \* They possess discontinuous endothelial cells.
  - \* They possess discontinuous basal lamina.
  - \* Macrophages may be located in or along the outside of the endothelial wall.
- Distribution: Red bone marrow, liver, spleen and certain endocrine glands.

**Notes:-**

**In Continuous blood capillaries the junctions between endothelial cells are fasciae occludens which prevent passage of many molecules so they have to move through carrier-mediated transport.**

**Veins:**

- Thickness of the wall: thinner than the accompanying artery
- **T. Intima:** no internal elastic lamina
- **T. Media:** Thinner than T. Adventitia
- \* Consists of: Fewer SMCs and collagen fibers and fibroblasts
- **T. Adventitia:** thicker than T. Media

**Valves of veins:-**

Valve of a vein is composed of 2 leaflets

Each leaflet has a thin fold of the T. Intima.

Components:

**Endothelium**

**Core of C.T.**

**Notes:-**

**Function:** prevent the backflow of the blood  
**Abundant in the veins of the leg**