

Circulatory system

The Circulatory system consist of:

1-blood vascular system.

The blood vascular system composed of heart, arteries, capillaries and veins (convey the products of metabolism).

2-lymphatic vascular system.

Lymphatic system begins in the lymphatic capillaries, closed ended tubules, anastomosis and terminate in the blood vascular system in large vein then heart. The function of the lymphatic system is to return to the blood the fluid in the interstitial spaces of the tissue. This fluid contributes to the formation of liquid part of the lymph during passing through lymphoid organs will bring lymphocytes and other immunologic factors.

General structure of the blood vessels.

1- Generally three tunics are formed the wall of the blood vessels.

2- blood vessels are structurally adapted according to physiologic requirement therefore, pulmonary artery (low pressure) have thinner wall, while renal and carotid (high pressure) have thicker wall.

Tunica:

A-Tunica intima :

- 1- A layer of endothelial cells which rest on the basement membrane.
- 2- Subendothelial layer compose of loose connective tissue and occasional smooth muscle cells. The tunica intima separated from tunica media by an internal elastic lamina, which compose of elastin and is fenestrated.

B- Tunica media:

Concentric layers of smooth muscle cells among smooth muscle cells, elastic fiber, reticular fiber and proteoglycans are interposed. The capillary, post capillary and venules the tunica media is replaced by pericytes.

C- Tunica adventitia:

Composed of collagen and elastic fiber. The tunica adventitia contain .

1- Vassavosorum :

Vessels of the vessel found in adventitia of large vessels which provide metabolites to the adventitia and outer media as the diffusion alone is adequate for nourishment. Vasavosorum are frequent in the vein than in artery because the oxygen and nutrition substance are little in vein.

2- Nervivosorum :

Unmyelinated sympathetic nerve fibers , which found in the tunica adventitia.

Blood vessels are classified into :-

a- Arteries . b- capillaries . c- veins . d- sinusoid.

A- Arteries :

Classify into three types according to their size:

- 1- Arteriole.
- 2- Small and medium size arteries .
- 3- Large arteries.

Arteriole:

- 1- Less than 0.5 mm in diameter.
- 2- Narrow lumen which lined with endothelium cells.
- 3- Tunica intima has only endothelial layer and lack an internal elastic lamina.
- 4- Tunica media is muscular and no external elastic lamina.
- 5- Tunica adventitia is narrow, poorly development.

Medium and small arteries:

- 1- The tunica intima is similar to that of arteriole except that the subendothelial layer is somewhat thicker and a few smooth muscle cells present .
- 2- An internal elastic lamina is prominent.
- 3- The tunica media may contain up to 40 layers of smooth muscle cells.
- 4- An external elastic lamina is present .

5- Tunica adventitia consists of collagen and elastic fibers and adipose cells.

6- Vasa vasorum and nervivascularia are present in the tunica adventitia.

Large elastic artery:

1- Large arteries have large diameter as in aorta .

2- Large arteries have wide lumen and subendothelial layer is thick and endothelial layer is present.

3- Tunica intima is thicker than that of other types of arteries, present internal elastic lamina.

4- Tunica media is the thickest of three layers and consists of a series of concentrically arranged perforated elastic lamina and smooth muscle cells, elastic and collagen fibers. Not present of external elastic lamina.

5- Tunica adventitia have less elastic fibers and more collagen fiber.

Histophysiology of arteries :

- Large arteries called carries arteries because their major function is transporting of blood.
- Medium size arteries called distributed arteries because their major function is furnish blood to the various organs.
- Aneurysm :dilation of arteries when the tunica media of artery is weakened genetically and the wall of artery may dilated and may rupture.
- Atherosclerotic : focal thickening of intima which lead to destruction of elastic tissue and loss of elasticity.

- Infarction : death of tissue due to obstruction of blood supply which lead to necrosis due to lack of metabolite. This case occur commonly in heart, kidney and cerebrum more than other region.

B- Capillaries :

Tubes composed of a single layer of endothelial cell of mesenchymal origin. The diameter 7-9 um and 0.25 – 1 mm in length. In adrenal cortex, renal medulla capillaries may reach to 50 mm in length. In cross section the wall of capillary consist of one cell layer rest on basal lamina and their nucleus bulge into the capillary lumen. There are pericytes, mesenchymal cells with long cytoplasmic processes that surrounding the endothelial cells.

Capillaries classification:-

The capillaries classified into four types according to structures of endothelial cells walls.

- 1- Continuous or somatic capillaries .
- 2- Fenestrated capillaries with diaphragm
- 3- Fenestrated capillaries with out diaphragm.
- 4- Discontinuous sinusoidal capillaries.

Function of capillaries:

- 1- Permeability (exchanges vessels).
- 2- Metabolic function.
- 3- Anti thrombogenic function.

Carotid body:

- Lie dorsal to bifurcation of common carotid artery
- Contain chemoreceptor s.
- Sensitive to low oxygen tension, high CO₂ and low arterial ph.

Carotid sinus:

- Lie in the internal carotid artery at it junction with common carotid artery.
- Contain barareceptors.
- Sensitive to changes in blood pressure.

C- veins:

Veins can be classified into :

- 1- Venules.
- 2- Small vein and medium veins
- 3- Large vein.

Venules.

- Venules are similar to capillaries but are larger (20 um in diameter).
- Venules have thin walls.
- Tunica intima compose of endothelium.
- Tunica media compose of few smooth muscle cells.
- Tunica adventitia is thicker
- Internal and external elastic lamina not present.

Small or medium veins:

- Have diameter 1-9 mm and large lumen.
- The wall relatively thin.
- Tunica intima has thin subendothelial layer.
- Tunica media consist of small bundles of smooth muscle cells .
- Tunica adventitia has well development .
- Internal and external elastic lamina are not present.

Large vein:

- Tunica intima well developed .
- Tunica media much thinner with few layer of smooth muscle cells
- Tunica adventitia is thickest.
- Internal and external elastic lamina not present.

Heart : the heart consist of :

A- Tunics of the heart:

- 1- Endo cardium :
- 2- Myocardium:
- 3- Epicardium:

Endocardium:

It is inner layer of heart which completely lined the ventricles and atria and consist of :

- Endothelium: single layer of squamous endothelial layer resting on the basement membrane.

- Subendothelium which consist of (loose connective tissue) collagen and elastic fiber and smooth muscle cells.
- Subendocardium : which consist of collagen and elastic fibers vein, nerve, nerve and branches of impulse conducting system.

Myocardium:

It is the thickest layer of the tunics which consist of cardiac muscle cell .

Epicardium:

It is the visceral layer of pericardium which covered by simple squamous epithelium .

C-valves:

Consist of central core of dense fibrous connective tissue lined on both side by endothelial layer. The base of the valve attached to annuli fibrosis of the fibrous skeleton.

D-structures that control heart beat:

It is called impulse conducting system . impulse for cardiac contraction begins in specialized muscle cell of sinoatrial node then spread to atrioventricular node and contain in the bundles of his.

1- Sinoatrial node(S.A. node).

Compose of thin, fusiform. Highly branched modified cardiac muscle cells that are distinguished by small diameter and little myofibrils. These nodal fibers are separated by large amount of highly vascularized containing sympathetic and parasympathetic

nerve fibers and ganglionic cells then continuous with cardiac muscle cells.

2- Atrioventricles node.(A.V.node):

This node has structure like that of S.A. node where is compores of irregularly arranged, small, branching nodal fibers that are continuous with atrial myocardial fibers and purkinji fibers of A.V. node bundles.

3- Atrioventricular bundle of his:

It is lie in the bifurcation and sending branches to both ventricles is formed by purkinje fiber.

Purkinje fibers characteristics :

- Large diametr.
- Large spherical nuclei centrally in location
- Little myofibrils which located in peripheral of fibers.
- Continuous with myocardial muscle cells
- Divided into right and left branches.

Sinusoids:

- present in liver.
- Larger than capillaries.
- Uniform in diameter.
- More permeable than capillaries.
- Blood flow may reach to zero.
- Absence of surrounding basal lamina.

Sinusoidal capillaries:

- Smallest blood vessels for endocrine organs.
- Have both sinusoid and capillaries.
- Large diameter than capillaries and sinusoid.
- Endothelial lining of sinusoidal capillaries is always fenestrated.