



CARDIOVASCULAR SYSTEM

جامعة ساوة

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المرحلة الأولى

Cardiovascular system

The circulatory system consists of the heart, vessels and blood each of which is essential to the life of a multicellular organism.

BASIC COMPONENTS OF CIRCULATORY SYSTEM

- a. Blood: Blood is the vehicle for oxygen, nutrients, and wastes.
- b. Blood Vessels: Blood vessels are the conduits, or tubes, through which the blood is moved.
- c. Heart: The heart is the pump which provides the primary motive force.
- d. Capillaries: The capillaries, are very small vessels, provide exchange areas. For example, in the capillaries of the lungs, oxygen is added and carbon dioxide is removed from the blood.

The Heart : is a muscular organ that pumps blood around the body by circulating it through the vascular system. It is found in the middle of thoracic cavity.

Chambers of Heart

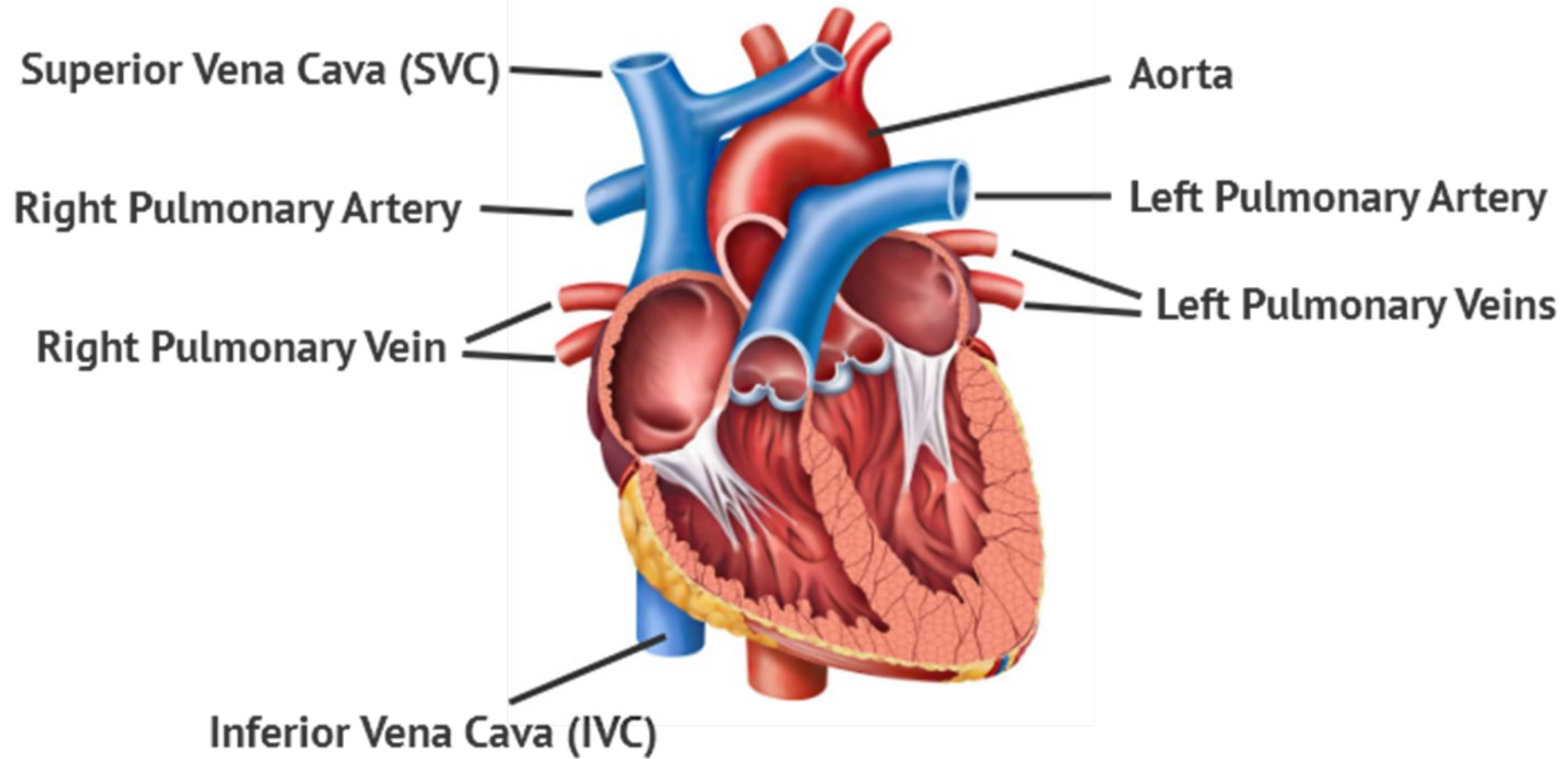
Heart has four chambers.

- 1) Two of them are upper chambers called atria .
- 2) Two lower chambers are called ventricles.

The two atria are separated by interatrial septum. The two ventricles are separated by interventricular septum.

Blood Vessels attached to Heart

1. Superior and inferior vena cava - carrying deoxygenated blood from parts of body to right atrium.
2. Pulmonary artery carrying venous blood to lungs from right ventricle.
3. Pulmonary veins carrying oxygenated blood from lungs to the left atrium of heart.
4. Aorta carrying oxygenated blood to all parts of body from left ventricle of heart



Atrium

Right Atrium: The right atrium receives deoxygenated blood from the superior and inferior vena cavae, and from the coronary veins. It pumps this blood through the right atrioventricular orifice (guarded by the tricuspid valve) into the right ventricle.

Interatrial Septum: The interatrial septum is a solid muscular wall that separates the right and left atria.

Left Atrium: The left atrium receives oxygenated blood from the four pulmonary veins, and pumps it through the left atrioventricular orifice (guarded by the mitral valve) into the left ventricle.

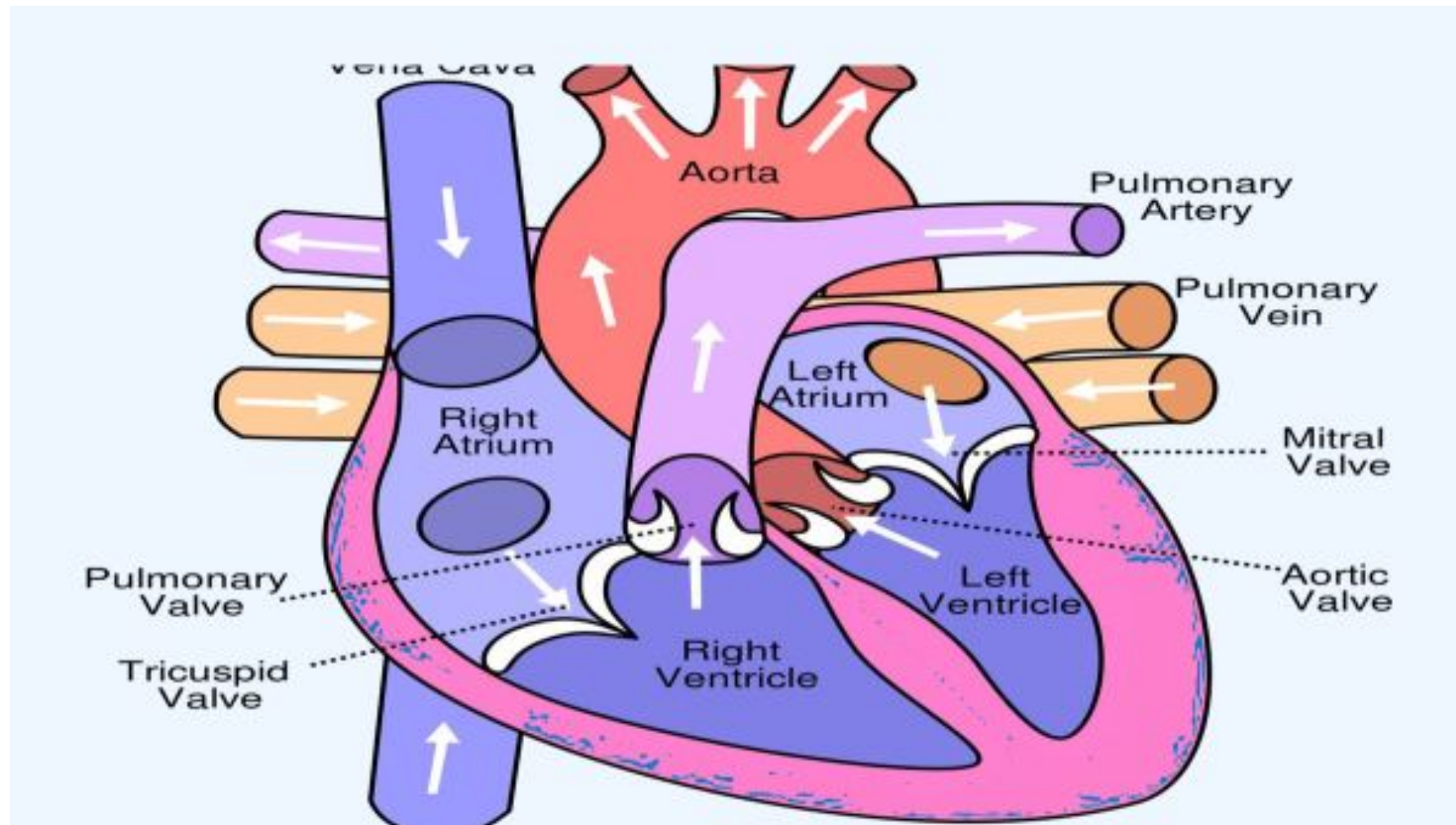
Ventricles

The left and right ventricles of the heart receive blood from the atria and pump it into the outflow vessels; the aorta and the pulmonary artery respectively.

Right Ventricle: The right ventricle receives deoxygenated blood from the right atrium, and pumps it through the pulmonary orifice (guarded by the pulmonary valve), into the pulmonary artery.

Interventricular Septum: The interventricular septum separates the two ventricles, and is composed of a superior membranous part and an inferior muscular part.

Left Ventricle: The left ventricle receives oxygenated blood from the left atrium, and pumps it through the aortic orifice (guarded by the aortic valve) into the aorta.



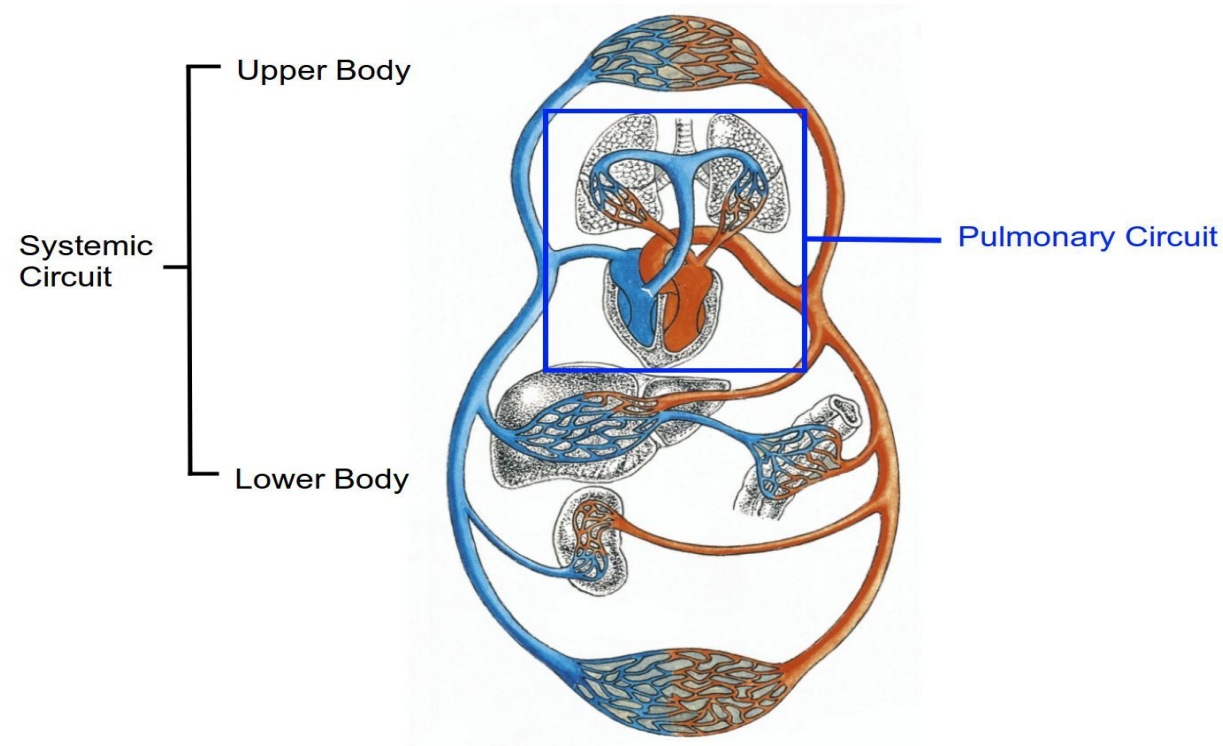
The Pulmonary and Systemic Circuits

A. Pulmonary circuit:

which carries blood to the lungs for gas exchange and returns it to the heart.

B. Systemic circuit:

which supplies blood to every organ of the body, including other parts of the lungs and the wall of the heart itself



Histology of Cardiovascular system

The Circulatory system is categorized as:

1-Blood vascular system; consist of:

- a. Heart: function to pump the blood
- b. Vessels: (arteries, veins, capillaries)

2-Lymphatic vascular system; consist of:

- a- lymph vessels
- b- Organs

Circulatory system can be divided into:

- 1. *Macrovasculature*** (includes vessels with more than 0.1mm in diameter)
- 2. *Microvasculature*** (includes vessels with less than 0.1mm in diameter: arterioles, capillaries and postcapillary venules)

Blood vessels (BV)

General structure of BV

Blood vessels have 3 basic types of tissues:

- Endothelium.
- Smooth muscle cells.
- Connective tissue.

Vascular Endothelium

It is a special type of epithelium. It serves many functions , these are :

1. It forms a semipermeable barrier between plasma and interstitial fluids.
2. It converts angiotension I to angiotension II. The latter increase blood pressure.
3. It converts bredykinin , serotonin , prostaglandins & noradrenalin , thrombin to biologically inert compounds.

General structure of BV: generally, each BV is composed of 3 layers; these are from inside to outside:

1. Tunica intima(T I) subdivided into:

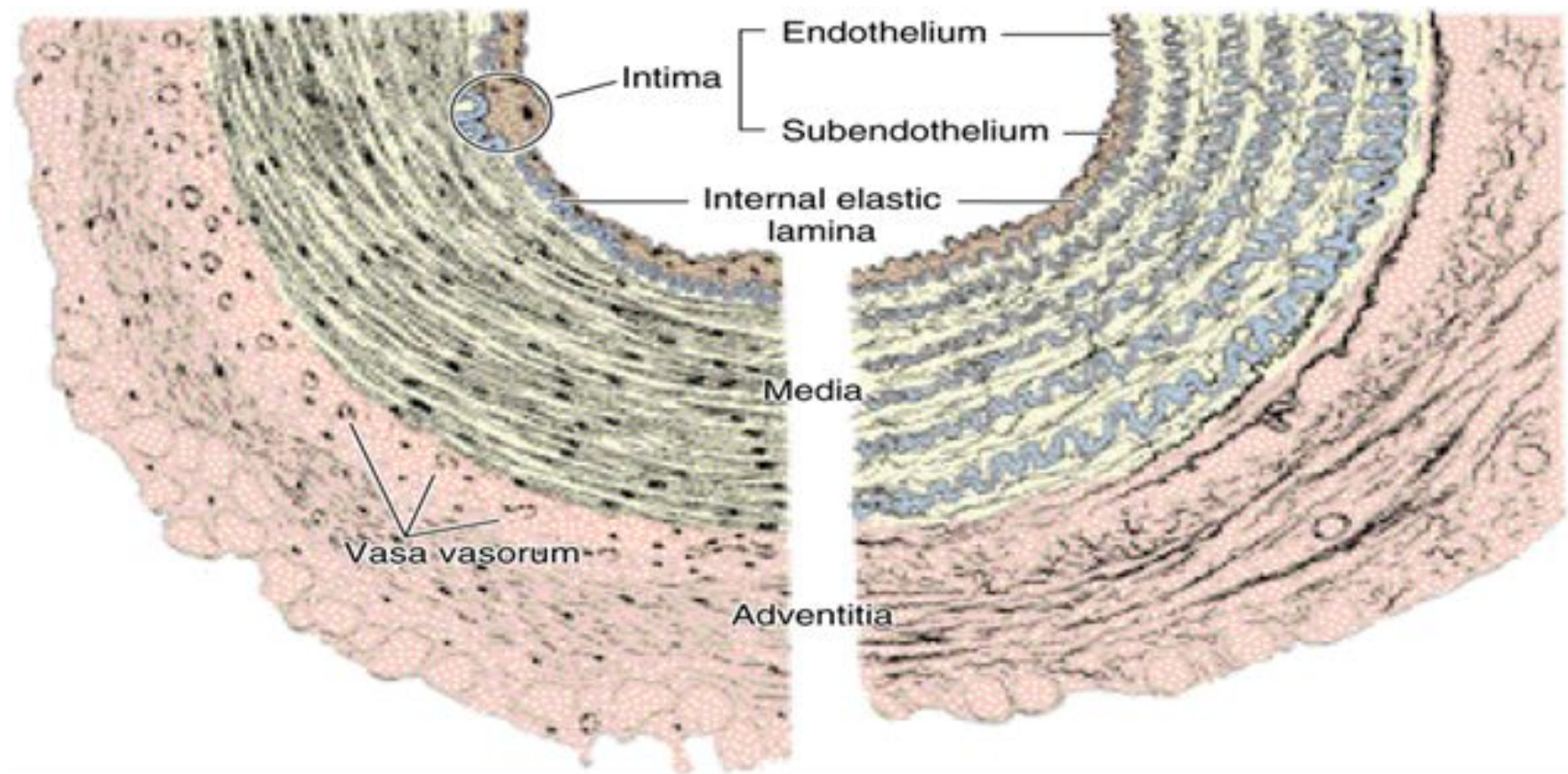
- a. Endothelium (simple seq. epith.) semipermeable barrier between the blood plasma and the interstitial fluid.
- b. Subendothelium: loose CT contain occasional smooth muscle cells.
- c. Internal elastic lamina: composed of elastin that has gaps (for diffusion of substances to nourish cells deep in the vessel wall). In arteries may have a slightly folded .

1. Tunica media(TM): composed of:

- a. Concentric layers of helically arranged smooth muscle cells.
- b. Elastic fibers & lamellae interspersed between smooth cells.
- c. Reticular fibers (collagen type III)
- d. Fibroblast
- e. Ground substance(proteoglycan and glycoprotein)
- f. In arteries, TM has a thinner external elastic lamina that separate it from TA.

1. Tunica adventitia (TA): consist of

- a. external elastic membrane
- b. Loose CT



In arteries, TM is usually the thickest layer, while in veins; TA is commonly the thickest layer.

Classification of arteries

- 1. Large size artery (elastic a)**
- 2. Medium size artery(muscular a) and small size artery**
- 3. Arterioles**

Classification of veins

- Venules**
- Small to medium size v.s**
- Large size v.s**

Classification of cap.s

Cap. are classified according to their ultrastructure into:

- 1-continuous or somatic cap.
- 2- fenestrated or visceral cap.
- 3- sinusoidal (or discontinuous) cap.

	Arteries	Veins	Capillaries
<i>Function</i>	Send blood from heart	Send blood to heart	Material exchange with tissues
<i>Pressure</i>	High	Low	Low
<i>Lumen Diameter</i>	Narrow	Wide	Extremely narrow (one cell wide)
<i>Wall Thickness</i>	Thick	Thin	Extremely thin (single cell thick)
<i>Wall Layers</i>	Three • Tunica adventitia • Tunica media • Tunica intima	Three • Tunica adventitia • Tunica media • Tunica intima	One • Tunica intima
<i>Muscle & Elastic Fibres</i>	Large amounts	Small amounts	None
<i>Valves</i>	No	Yes	No

Blood vessel of blood vessel (Vasa vasorum)

- Large vessels of diameter over 1 mm are supplied by small, nutrient BV that is called **Vasa vasorum** which means **vessels of the vessel** & in veins more than arteries
- vasa vasorum usually enter TA. network which penetrate as far as the deepest layer of the TM.
- Generally no cap.s are found in T I. However; in some large v.s, cap.s penetrate as far as T I (probably because of low venous pressure & O_2 tension).
- The TI & most internal region of the TM In intermediate & large diameter arteries are devoid of vasa vasorum which provides metabolites to the TA & TM.