ARTERIOLES

- The wall of the arterioles contains a little amount of elastic fibers and an increased amount of smooth muscle fibers. So, they are called resistance vessels.

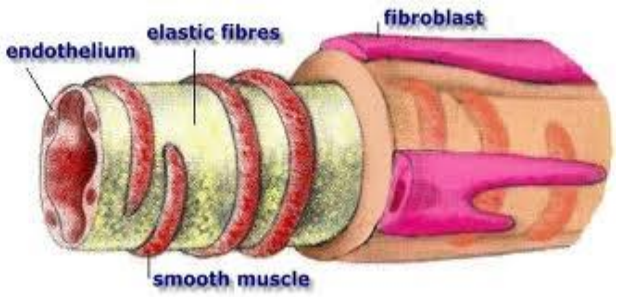


Fig.(57): Structure of arterioles

Histological:

Vascular smooth muscles are 2 types:

a. <u>Unitary smooth muscle</u>

<u>Site:</u>

1- Pre-capillary sphincters.
2- The inner sheath of vascular smooth muscles in arterioles.

<u>They are characterized by</u>

- spontaneous moygenic activity that is initiated in pacemaker areas
- The activity of unitary smooth muscle is regulated by local mechanisms and they have a few or no direct nerve supply. As they are regulated by local mechanisms the unitary smooth muscle regulates local blood flow.

b. <u>Multiunit smooth muscle.</u>

<u>Site:</u>

They predominates in the outer sheath of smooth muscles in arterioles, veins and arteriovenous shunts

<u>It is characterized by:</u>

1-It does not contract spontaneously.
2- It does not react to stretch.
3-They are regulated by central mechanisms.

Functions of arterioles:

1. **Control peripheral resistance**

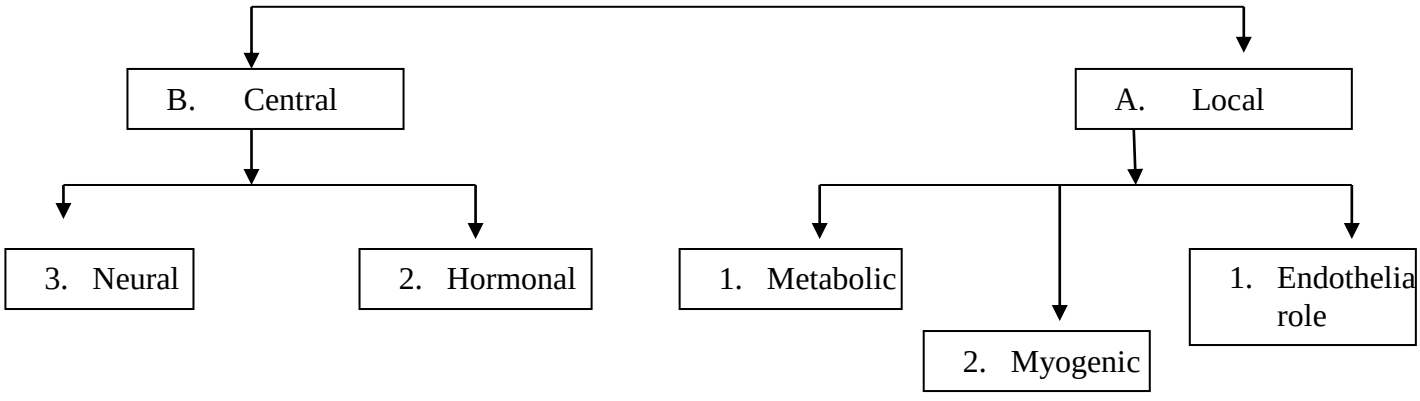
- As A.B.P = C.O.P X P.R. So, arteriolar V.C → ↑ P.R and accordingly increased ABP.

2. **Redistribution of blood flow**

- The arterioles play an important role in distribution of blood flow to various organs of the body. The blood flow to a given organ is changed by variation in the diameter of its arterioles i.e. arteriolar V.D in a given organ leads to increased flow, and arteriolar V.C leads to decrease its blood flow.
- The blood flow to a given organ is not determined by the size of the organ but by its role in homeostasis and by its metabolic activity.
    - Moving along the vasculature away from the heart, the largest pressure drop in the circulatory system occurs along the **arterioles**
- During muscular exercise the C.O.P. is increased and redistribution of the blood flow to various organs occurs as flow:
    - The blood flow to the skeletal muscles increases 10 times.
    - The blood flow to the heart increases 4 times.
    - The blood flow to the skin increases 4 times to help heat loss from the body.
    - The blood flow to the brain is not changed.
    - The blood flow to the kidney and abdominal viscera is decreased.

REGULATION OF THE DIAMETER OF ARTERIOLES

The diameter of arterioles is regulated by 2 mechanisms:



A. Central regulation

1. Neural mechanism

❖ Innervations of arterioles:

a. Sympathetic Innervations.

i. Sympathetic vasoconstrictor fibers.

- These fibers are adrenergic fibers.
- They discharge continuously to the arterioles forming the basal V.C tone.
- When the rate of discharge increases above the basal level it leads to V.C of arterioles & ↑ ABP.
- When the rate of discharge is decreased below the basal level the tone is decreased and V.D occurs leading to decreased P.R and ↓ ABP
- The most important function of sympathetic adrenergic fibers is to maintain the normal arterial blood pressure to ensure adequate blood flow to the organs all the time especially the heart and the brain.

ii. Sympathetic Vasodilator fibers: These fibers supply.

a) Coronary blood vessels: V.D occurs by two mechanisms.

- Indirect one by the effect of metabolites.
- Direct mechanism by adrenaline which act on β- receptors which are more frequent than α- receptors.

b) Arterioles of skeletal muscles.

- Sympathetic Cholenergic V.D fibers which produce V.D of skeletal muscle blood vessels before the beginning of exercise and before the accumulation of metabolites that occur during the exercise and producing V.D .These fibers does not play an important role in regulation of arterial blood pressure .

N.B: Also, skeletal muscles receive sympathetic adrenergic fibers which produce V.C.

Parasympathetic innervations

Parasympathetic V.D fibers to:

i. The parasympathetic fibers to supply the genital tract these are the pure V.D fibers
ii. Parasympathetic fibers to G.I.T: The vasodilator action is mainly due to metabolites.

2. Hormonal mechanisms

i. Adrenaline: The effect of adrenaline depends on its concentration.
   - Low concentration produces V.D because it acts on β receptors.
   - While high concentration produce V.C because it acts on α receptors.
ii. Nor-adrenaline: in low &high concentration produce V.C because it acts only on alpha receptors
iii. Angiotensin II
iv. A.D.H

i. Histamine
ii. ANP

B. Local mechanisms.

It is an auto regulatory mechanism which include.

Auto regulation

It is the ability of the tissue to regulate its own blood flow according to its metabolic activity i.e. when the activity is increased the tissue produce local V.D in its arterioles to increase the blood flow, and when the activity is decreased arteriolar V.C occurs to decrease the tissue blood flow.

This autoregulatory mechanism occurs by:

1. **Local oxygen tension.**

   This mechanism regulates the blood flow according to the oxygen needs of the tissue and it is explained as follow:

   - Decreased tissue activity leads to decreased metabolites and increased oxygen tension, which leads to local V.C.
   - Increased tissue activity leads to increased oxygen utilization and decreased oxygen tension which leads to local V.D to increase the blood flow that carry more oxygen to the tissue

2. **Metabolites(metabolic theory of Autoregulation)**

   When the blood flows to the tissue decrease, metabolites accumulate and the blood vessels dilate, and when the metabolites are washed out the vessels constrict to decrease the flow.

N.B: Vasodilator metabolites as:

- ++ H+ ion concentration (Acidosis).
- Increased Co2 tension.
- ++ Lactic acid
- Histamine.

3. **Intrinsic myogenic response (Bayliss response)**

Increased pressure leads to stretch of the blood vessel wall leading to stretch of the vascular smooth muscles, leading to its contraction

4. **Role of endothelium.**

The endothelium plays a major role for regulation of local blood flow to the tissues through the following substances.

a. Prostacycline

- Prostacycline is produced by endothelial cells
- Inhibit platelet aggregation and cause vasodilatation.

b. thromboxan A2:

- It is formed by the platelets to promote platelet aggregation
- Also, it causes vasoconstriction.

c. Endothelium derived relaxing factor (NO).

- It plays a key role in V.D
- N.O is synthesized from arginine by the enzyme nitric oxide synthase.
- N.O produces cyclic G.M.P which in turn mediates relaxation of the vascular smooth muscles.

d. Endothelins

Actions of Endothelin

- It is the most **potent V.C agent** yet isolated.
- It has positive inotropic and chronotropic effects on the myocardium.
- It stimulates intense V.C of the coronary arteries.
- Decreased glomerular filtration rate and renal blood flow**.**
- Increased Na ion reabsorption through Hemodynamic actions.