



Cardiovascular Block

Physiology Team 430

11th Lecture

Coronary circulation

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Coronary Artery Anatomy

1. Coronary arteries:

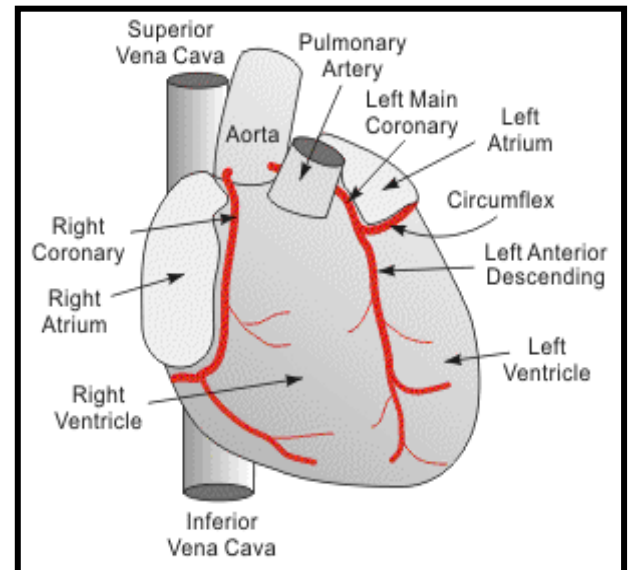
The FIRST branches of the aorta

a) Left coronary artery.

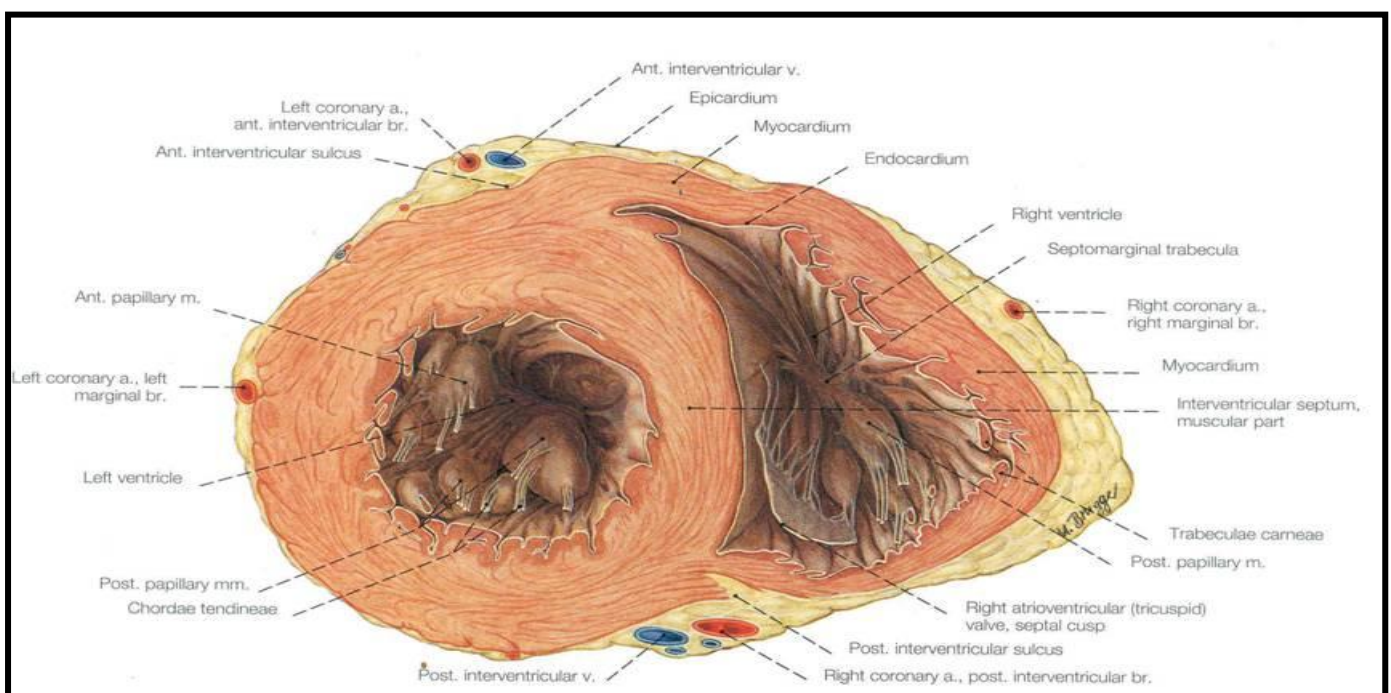
- Left anterior descending
(Interventricular Branches)
- Circumflex branches

b) Right coronary artery.

- Right marginal Branch.



- **Left ventricle** wall is thicker than Right ventricle
- Most of the **venous drainage** of the heart returns through the coronary sinus and anterior cardiac veins
- **The anastomosis** between right and left coronary arteries is not adequate



Properties of the cardiac muscle

The property	
1) resistant to fatigue	- Highly resistant to fatigue - Explanation: due to large number of mitochondria , myoglobins(a pigment storing O ₂) and good blood supply
2) Metabolism	- Mainly aerobic metabolism - At basal metabolic rate only 1% is anaerobic , it can increase to 10% in hypoxic conditions
3) Source of energy	- Fatty acids and triglycerides(60%) - carbohydrates (35%) - amino acids & ketone bodies (10%)
4)capillaries	The cardiac muscle has much more capillaries than skeletal muscles (they will provide it with more blood and O ₂ , As a result , it will utilize O ₂ more)
5) coronary blood flow	225 -250 ml/min (which is equal to 4 to 5 % of total cardiac output)
6) O ₂ consumption	- It consumes O ₂ more than any other organ in the body (8-10 ml O ₂ /min/100g)

■ Coronary Vascular Resistance :

Epicardial conductance vessels:-

Contribute only to a small % of resistance.

Intramyocardial vessels (arterioles):-

Contribute most to total coronary vascular Resistance.

Coronary circulation

- The coronary arteries supply blood flow to the heart, and when functioning normally, they ensure adequate oxygenation of the myocardium at all levels of cardiac activity.
- Blood flow mainly **in diastole**
- **In left ventricle :**
During systole : It drops due to compression of the muscle around vessels

■ Important notes :

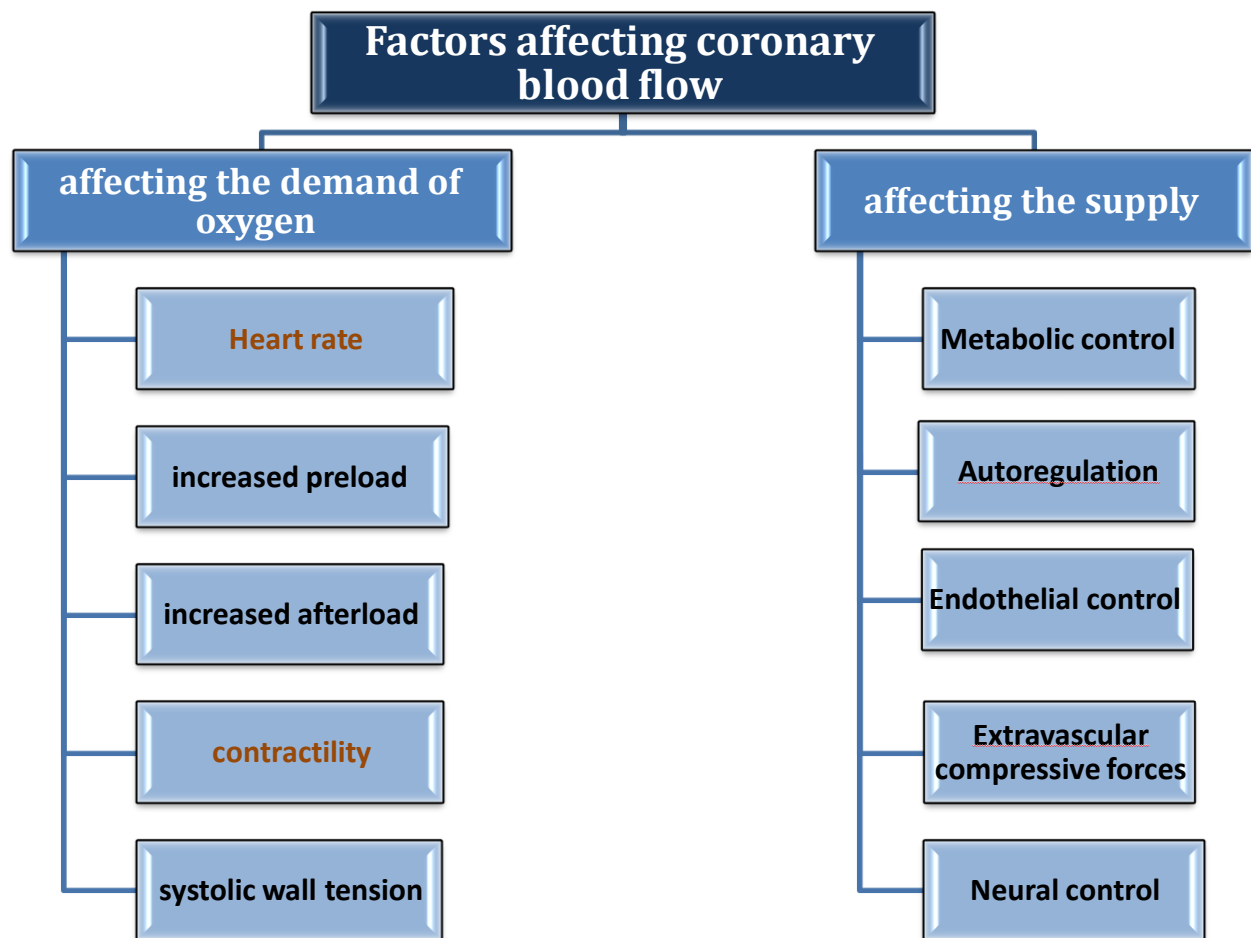
The subendocardial area is most prone to ischemic damage and myocardial infarction **WHY?!!** : because almost , there is no blood flow during systole (the blood flow is reduced greatly).

- The heart extracts oxygen to **a greater** extent than any other organ
 - **Increases in O₂** demand must be met by increased coronary blood flow
- Because :** the coronary sinus Po₂ is in range of 20-22 mmHg (sat%= 32-38%) , and these amounts makes the heart unable of extracting O₂ from them .

When the work of the heart increase 7 to 9 folds , the coronary blood flow must increase 3 to 4 folds to supply the extra nutrients

In aortic stenosis , Ischemia prone to develop due to increase in the ventricular pressure that leads to vessels compression

As a consequence: congestive heart failure, pumping action failure and low effective coronary perfusion occur .



- **Heart rate** : when it increases the demand of O₂ increases
- **Contractility** : has the same effect
- Changes in **preload** affect myocardial oxygen consumption less than do changes in the other factors

■ Factors affecting the supply :

These are group of factors that affect the vascular resistance:

1-Metabolic control: (Coronary circulation is very sensitive to myocardial tissue oxygen tension)

When the O₂ demand increases, the oxygen tension decrease, leading to vasodilatation and increase in blood flow by chemical factors like :

- 1- Adenosine
- 2-lack of o₂
- 3-Nitric oxide (NO)
- 4-prostaglandins
- 5-k⁺
- 6-H⁺
- 7- lactate
- 8-adenine nucleotide

2- Autoregulation : (↑ pressure → dilatation coronary → ↑ coronary blood flow)

Ability of a blood vessels to maintain constant blood flow over a range of arterial pressures

- This factor is independent from other determinants

3- Endothelial control :

Any damage to the endothelial will lead to :

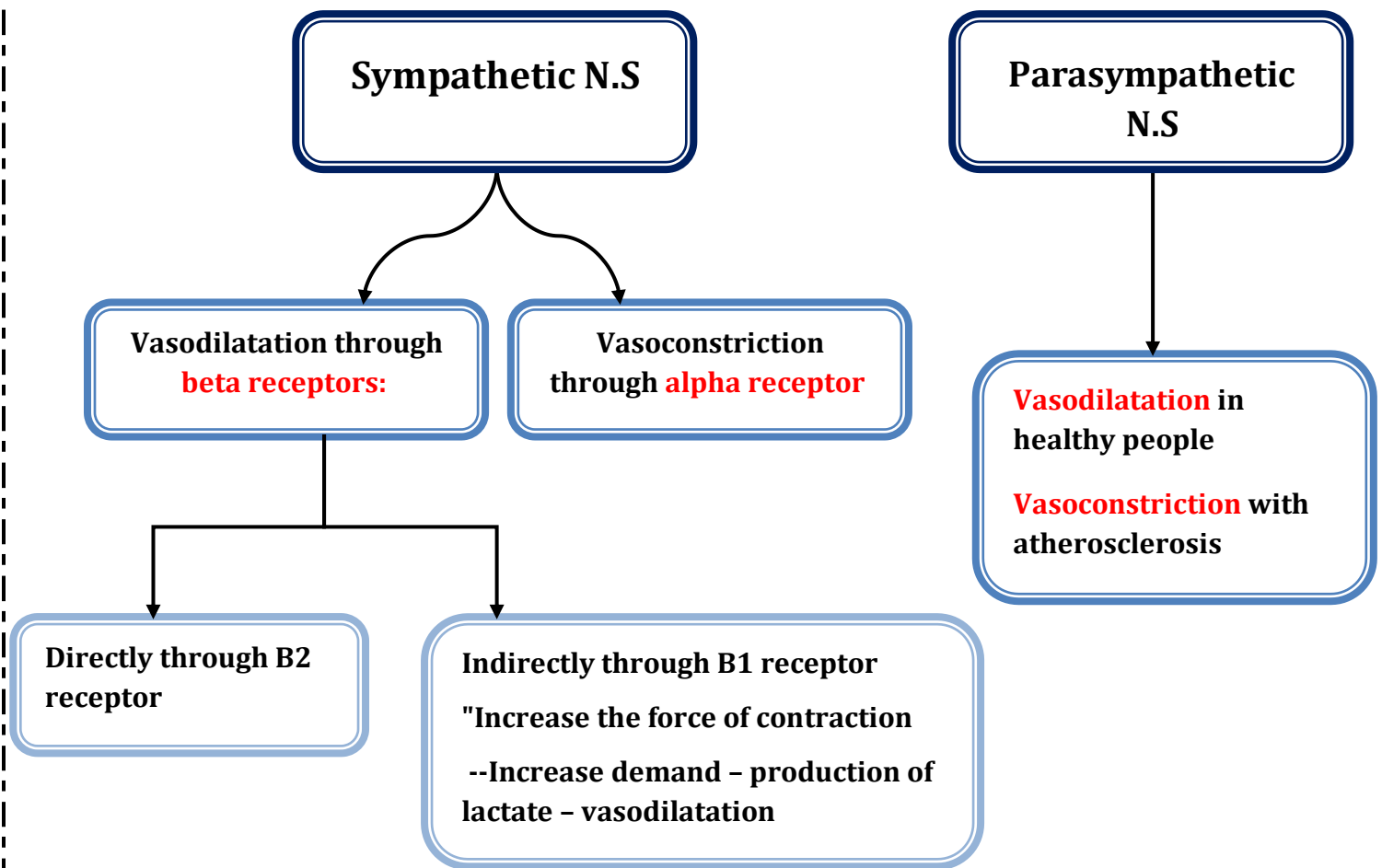
- decreased NO and prostacyclin
- increased endothelin production

Endothelin is a substance causing vasoconstriction

And this will lead to:

Vasoconstriction, vasospasm, thrombosis

4- Neural control : By the Autonomic nerves system



5- Extravascular Compressive Forces

The heart influences its blood supply by the squeezing effect of the contracting myocardium on the blood vessels coursing through the heart

■ Left Ventricle:

Early Systole → Initial Flow Reversal.

Remainder of Systole → Flow follows aortic pressure curve, but at a much reduced pressure.

Early Diastole → Abrupt pressure rise (80-90% of LV flow occurs in early diastole).

Remainder of Diastole → Pressure declines slowly as aortic pressure decreases.

■ **Right Ventricle:**

- Lower pressure generated **by thin right ventricle** in systole.
- **No reversal** of blood flow during early systole.
- **Systolic blood flow constitutes** a much greater proportion of total blood flow.

■ **Transmural Distribution of Myocardial Blood Flow :**

- Extravascular compressive forces **are greater in the subendocardium (inner)** and least near the subepicardial layer (outer).
- **Under normal resting conditions** this does not impair subendocardial blood flow as increased flow during diastole Compensates.

The subendocardium is more susceptible to ischemia than the midmyocardium or Subepicardium

Coronary artery diseases

1- Angina : it's caused by ischemia due to coronary heart disease

■ **Angina pectoris :**

Characterized by chest pain may radiate to neck, jaw, left arm

■ **Exertional angina (Classical) :** increase with exertion "excercise"

■ **Treatment :**

Glyceryl trinitrate (0.5 mg under tongue) **Causing vasodilatation**

For your information :

Investigation : ECG: maybe normal

2- Myocardial infarction:

Clinical features:

- **Chest pain** : even at rest & last for hours
- **Sever pain** : sudden onset , but can develop gradually
- **Associated with** : sweating , vomiting

In 20% of the cases there is no pain (Like in subendocardial infarction)

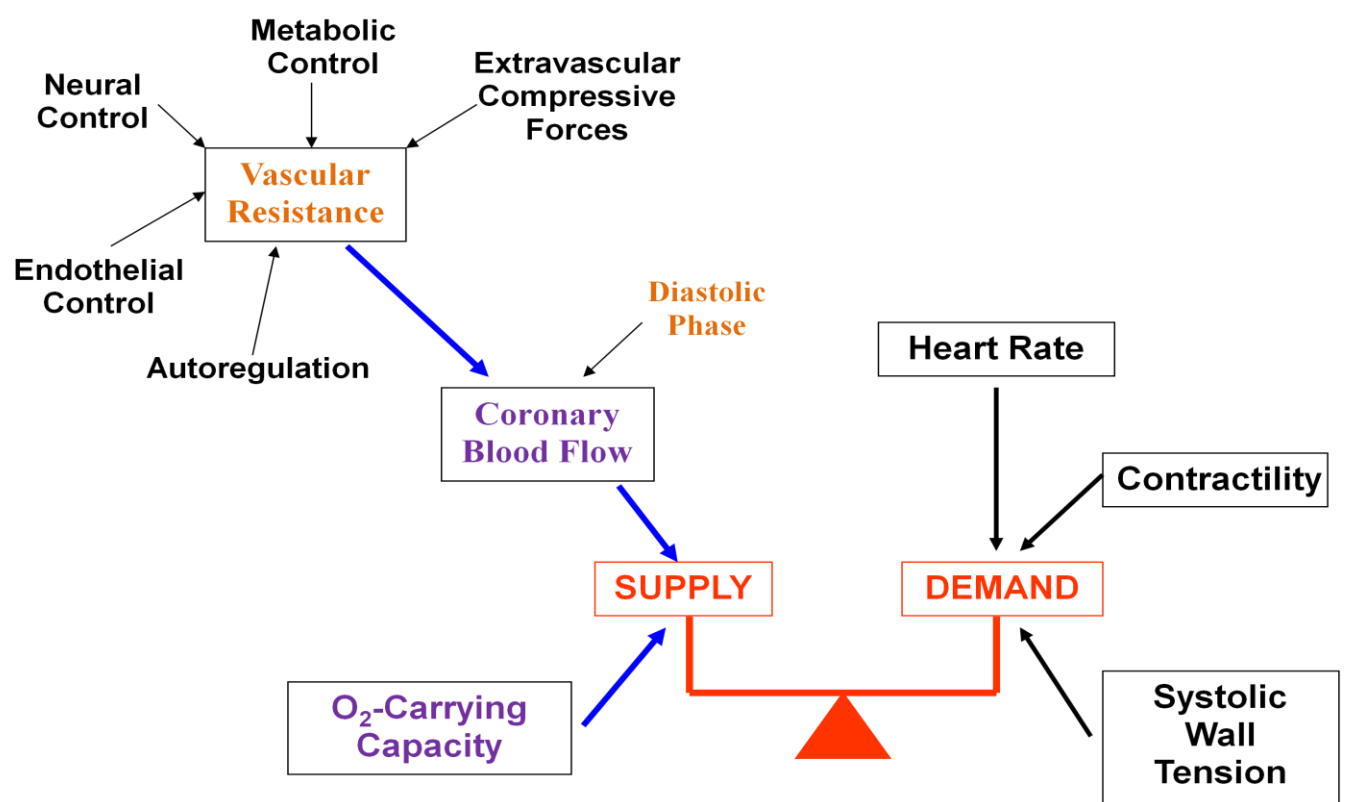
- **Hypotension**

Investigation:

Cardiac enzyme – CK (creatine kinase),

AST (aspartate aminotransferase)

LDH (lactic dehydrogenase)



Good Luck 😊