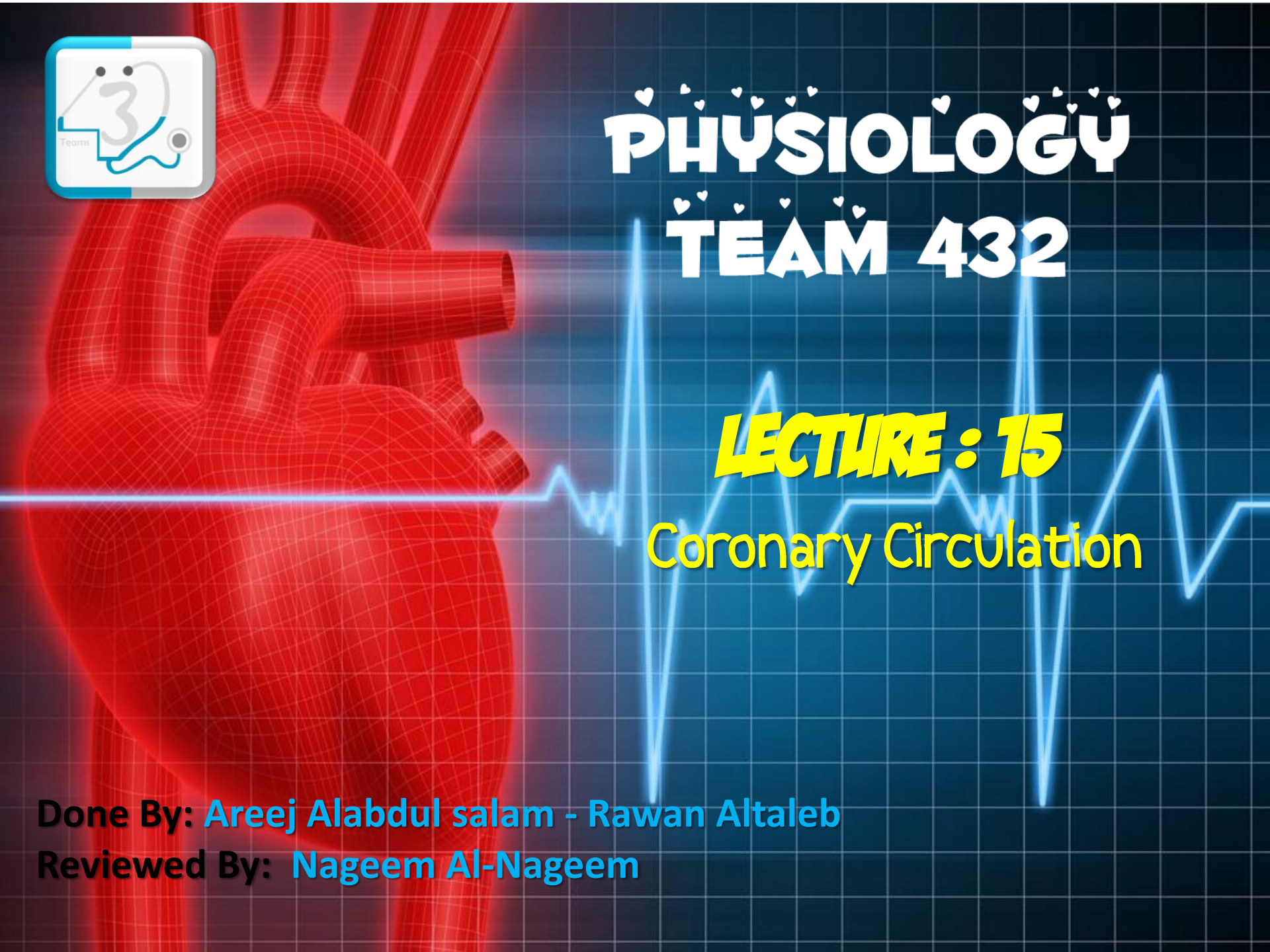


PHYSIOLOGY TEAM 432

LECTURE : 15

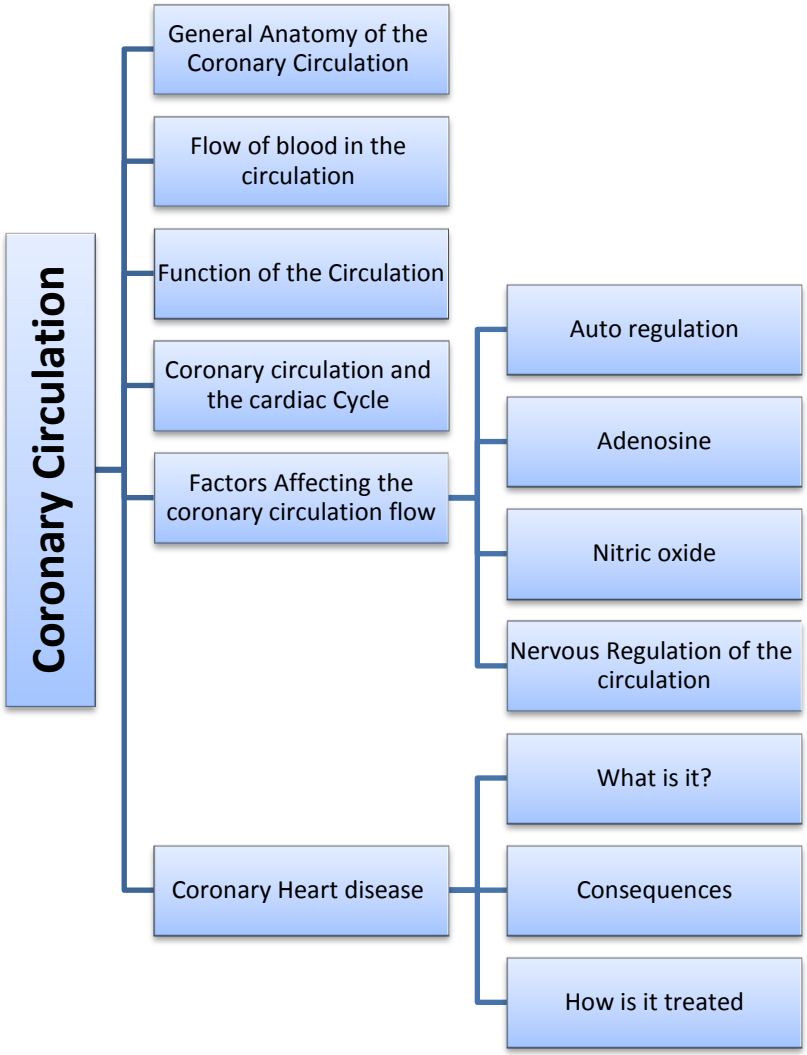
Coronary Circulation

Done By: Areej Alabdul salam - Rawan Altaleb
Reviewed By: Nageem Al-Nageem

OBJECTIVES

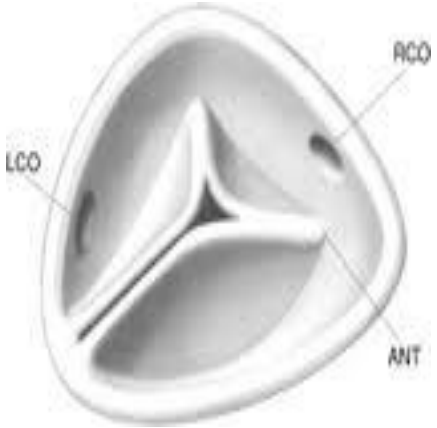
Were Not given

MIND MAP


Coronary Circulation
General Anatomy of the Coronary Circulation
Flow of blood in the circulation
Function of the Circulation
Coronary circulation and the cardiac Cycle
Factors Affecting the coronary circulation flow
Auto regulation
Adenosine
Nitric oxide
Nervous Regulation of the circulation
Coronary Heart disease
What is it?
Consequences
How is it treated

The major vessels of the coronary circulation are:

- **left main coronary**
  - left anterior descending
  - circumflex
- **right main coronary**



The left and right coronary arteries originate at the base of the aorta from openings called the coronary ostia located behind the aortic valve leaflets.

Coronary blood flow:

The right coronary artery has a greater flow in 50% of population.

The left has a greater flow in 20% .

Flow is equal in 30%.

Coronary blood flow at rest in humans = 250 ml/min

(5% of cardiac output)

=the amount of blood pass through coronary artery per minute

All of the a above is normal distribution

Venous blood:

Most of the venous drainage of the heart returns through the coronary sinus and anterior cardiac veins.

Increase the number of blood vessels doesn't increase the blood flow

What is the function of coronary arteries?

normally)(The main function of coronary arteries is allow heart function and supply adequate oxygen to myocardium

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.

Constriction and dilation of the coronary arteries, governed primarily by local regulatory mechanisms, regulate the amount of blood flow to the myocardium in a manner that matches the amount of oxygen delivered to the myocardium with the myocardial demand for oxygen.

Coronary blood flow during Cardiac cycle

Most of the coronary flow occurs during diastole.

Diastole time is important for filing time

Extravascular compression during systole markedly reduce coronary flow.

At low coronary perfusion pressures, the endocardium is more susceptible to ischemia. This is because of extravascular compression.

Tachycardia , some arrthymias and compromised heart in emotional conditions shortens coronary filling time during diastole – this is particularly significant in patients with coronary artery disease where coronary flow is reduced and could lead to heart attack .

Pressures in systemic circulation is the force that push blood in vessels that supply the organs in tissue. So, we need some of this force to push blood in the coronary. so, we need diastolic aorta pressure to be mention within normal to push blood coronary. Other ways when there drop in diastolic pressure the filing in coronary will be compromised

Factors Affecting Coronary Blood Flow

Autoregulation: ability of the organism to regulate there own blood supply according to there metabolic recoupment or metabolic need) by constricting or dilatation of blood vessels using vasoactive substance)

Autoregulation:

Flow is tightly coupled to oxygen demand. This is necessary because the heart has a very high basal oxygen consumption (8-10 ml O2/min/100g).

In non-diseased coronary vessels, whenever cardiac activity and oxygen consumption increases, there is an increase in coronary blood flow (active hyperemia) that is nearly proportionate to the increase in oxygen consumption.

Good autoregulation between 60 and 200(not important) mmHg perfusion pressure helps to maintain normal coronary blood flow whenever coronary perfusion pressure changes due to changes in aortic pressure.

Factors affecting coronary blood flow, cont.,....

2- Adenosine :

An important coronary dilator that mediates autoregulation. (VERY IMP. FACTOR)

3- Nitric oxide: coronary vasodilator.

(released by endothelial cells)

In order for Autoregulation to function proerly it needs Adenosine and nitric oxide

Factors affecting coronary blood flow, cont.,….

Systemic circulation is supplied only by sympathetic, however, the coronary circulation is supplied by sympathetic and parasympathetic

4- Nervous regulation:

- Activation of sympathetic nerves innervating the coronary vasculature causes only transient vasoconstriction mediated by a1-adrenoceptors(oppesite to systemic which will lead to dilatation). This brief vasoconstrictor response is followed by vasodilation caused by enhanced production of vasodilator metabolites (active hyperemia) due to increased mechanical and metabolic activity of the heart resulting from b1-adrenoceptors activation of the myocardium.
- Therefore, sympathetic activation to the heart results in coronary vasodilation and increased coronary flow due to increased metabolic activity (increased heart rate, contractility) despite direct vasoconstrictor effects of sympathetic activation on the coronaries.

Factors affecting coronary blood flow, cont.,….

- Parasympathetic stimulation of the heart:

(i.e., vagal nerve activation) elicits modest coronary vasodilation (due to the direct effects of released acetylcholine on the coronaries). it will dilate the vessels but to the basal (normal)level.

- However, if parasympathetic activation of the heart results in a significant decrease in myocardial oxygen demand due to a reduction in heart rate, then intrinsic metabolic mechanisms will increase coronary vascular resistance by constricting the vessels. During sleeping the parasympathetic takes the upper hand in innervations(leading to bradycardia).

What is the most vulnerable portion of the heart to ischemia?

- Because there is no blood flow during systole in the subendocardial portion of the left ventricle, this region is prone to ischemic damage and is the most common site of myocardial infarction.

Decrease in aortic pressure, hypertrophy and decrease blood flow ,tachyarrhythmia (affecting the filling time)

Oxygen consumption by the heart and energy substrate

- At rest, O2 consumption by beating heart = 9 ml/100 g/min.
- During ms.ex and other conditions increases in myocardial O2 consumption are met by increases in CBF.
- O2 consumption by the heart is determined by:
  - Intra-myocardial tension.
  - Contractile state of the myocardium.
  - Heart rate.

  An increase in afterload causes greater increase in O2 than an increase in preload does. This is why angina due to deficient delivery of O2 to the myocardium is more common in aortic stenosis than in aortic regurge.

What are the physiological and clinical consequences of coronary artery disease

- When CAD restricts blood flow to the myocardium, there is an imbalance between oxygen supply and oxygen demand.
- When the oxygen supply is insufficient to meet the oxygen demand (reduced oxygen supply/demand ratio, the myocardium becomes hypoxic. This is often associated with chest pain (angina) and other clinical symptoms. Severe ischemia can lead to anoxia and infarction of the tissue.
- Furthermore, acute or chronic ischemia caused by CAD can impair cardiac mechanical and electrical activities leading to heart failure and arrhythmias.

What is coronary artery disease?

- Coronary artery disease (CAD) causes changes in both structure and function of the blood vessels. Atherosclerotic processes cause an abnormal deposition of lipids in the vessel wall, leukocyte infiltration and vascular inflammation, plaque formation and thickening of the vessel wall. These changes lead to a narrowing of the lumen (i.e., stenosis), which restricts blood flow.
- Early in the disease process, the endothelial cells that line the coronary arteries become dysfunctional. Because the endothelium produces important substances such as nitric oxide that are required for normal coronary function, endothelial dysfunction can lead to coronary vasospasm, impaired relaxation, and formation of blood clots that can partially or completely occlude the vessel.

How is coronary artery disease treated?

- CAD results in myocardial ischemia, which leads to chest pain(angina)and cardiac mechanical and electrical dysfunction.
- The goal in treating CAD is to restore normal coronary perfusion, or if that is not possible, then to reduce the oxygen demand by the heart (i.e., normalize the oxygen supply/demand ratio) so as to minimize myocardial hypoxia.
- In severe CAD in which one or more coronary arteries is very stenotic, some patients will have a stent implanted within the coronary artery to open up the lumen and restore blood flow.
- Other patients may undergo coronary artery bypass grafts in which the diseased segment is bypassed using an artery or vein harvested from elsewhere in their body (i.e., internal mammary artery).
- If the coronary is occluded by a blood clot, a thrombolytic drug may be administered to dissolve the clot. Anti-platelet drugs and anticoagulants are also given to patients with CAD. However, the vast majority of CAD patients are treated with antianginal drugs that reduce the myocardial oxygen demand by decreasing heart rate, contractility, afterload or preload (e.g ،.beta-blockers, calcium-channel blockers, nitrodilators, or they are treated with drugs that many prevent or reverse coronary vasospasm in patients with variant angina.

Narrowing in coronary arteries,1)acute spasm (treated it by vasodilator medication). 2)irreversible spasm(treated it by angiography or bypass surgery)

SUMMARY

- Most of the coronary flow occurs during diastole.
- Factors Affecting Coronary Blood Flow:

  1- Autoregulation:

  2- Adenosine

  3- Nitric oxide: coronary vasodilator.

  4- Nervous regulation.
- O2 consumption by the heart is determined by:
  - Intra-myocardial tension.
  - Contractile state of the myocardium.
  - Heart rate.

THE END

If there are any problems or suggestions
Feel free to contact:

Physiology Team Leaders
Mohammed Jameel & Khulood Al-Raddadi

432100187@student.ksu.edu.sa
432200235@student.ksu.edu.sa

THANK YOU

Actions speak louder than Words