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DEPARTMENT: MEDICINE AND SURGERY

COURSE: PHYSIOLOGY

ASSIGNMENT:

1. DISCUSS THE LONG TERM REGULATION OF MEAN ARTERIAL BLOOD PRESSURE
2. WRITE SHOTE NOTES ON THE FOLLOWING

a. PULMONARY CIRCULATION

b. CIRCLE OF WILLIS

c. SPLANCHNIC CIRCULATION

d. CORONARY CIRCULATION

e. CUTANEOUS CIRCULATION

1. DISCUSS THE CARDIOVASCULAR ADJUSTMENT THAT OCCURS DURING EXERCISE.
2. Long-Term Regulation of mean arterial Blood Pressure

Blood pressure (BP) is the pressure of circulating blood on the walls of blood vessels. Most of this pressure is due to work done by the heart by pumping blood through the circulatory system.

In healthy individuals the total volume of the extracellular fluid is proportional to the systemic arterial pressure. Although this may appear to be an intuitive relationship, the physiological mechanism by which these two variables are linked is rather complex and is described below. However, in a variety of disease states the connection between ECF Volume and arterial pressure is deranged which can lead to increases in ECF volume without proportional enhancements of systemic arterial pressure.

In healthy individuals, increases in ECF volume result in a proportional increase in the total blood volume. As described in our discussion of the [vascular function curve](http://pathwaymedicine.org/vascular-function-curve), an increase in total blood volume will enhance the "Mean Systemic Pressure" which in turn increases the venous return and thus the cardiac preload. Courtesy of the [Frank-Starling Relationship](http://pathwaymedicine.org/Frank-Starling-Relationship), increased preload on the heart will enhance the cardiac output. Finally, as discussed in [systemic arterial pressure regulation](http://pathwaymedicine.org/systemic-arterial-pressure-regulation), an increased cardiac output will boost the systemic arterial pressure so long as the SVR remains constant. In this way, an increase in ECF volume results in an increase in the arterial pressure; conversely, a decrease in ECF volume will yield a decline in arterial pressure

There are several physiological mechanisms that regulate blood pressure in the long-term, the first of which is the renin-angiotensin-aldosterone system **(RAAS)**.

Renin-Angiotensin-Aldosterone System (RAAS)

Renin facilitates the conversion of angiotensinogen to angiotensin I which is then converted to angiotensin II using angiotensin-converting enzyme **(ACE)**.Sodium is reabsorbed via the sodium-hydrogen exchanger. Angiotensin II also promotes release of aldosterone.ACE also breaks down a substance called bradykinin which is a potent vasodilator. Therefore, the breakdown of bradykinin potentiates the overall constricting effect.

Aldosterone promotes salt and water retention by acting at the distal convoluted tubule to increase expression of epithelial sodium channels. More sodium collects in the kidney tissue and water then follows by osmosis. This results in decreased water excretion and therefore increased blood volume and thus blood pressure.

#### 2a)PULMONARY CIRCULATION: The pulmonary circulation is the portion of the circulatory system which carries deoxygenated blood away from the right ventricle, to the lungs, and returns oxygenated blood to the left atrium and ventricle of the heart. The term pulmonary circulation is readily paired and contrasted with the systemic circulation. The Pulmonary Circulation Path Blood cells enter pulmonary circulation after returning from a trip around the body and enter the right atrium of the heart through two major veins, the superior and inferior vena cava. At this point in the journey, the blood cells do not contain any oxygen. From the atrium, the heart pushes the blood through the tricuspid [valve](https://www.wisegeek.com/what-is-a-valve.htm) into the right [ventricle](https://www.wisegeek.com/what-is-a-ventricle.htm) and then through the pulmonary valve into the pulmonary artery. The pulmonary artery splits in two and carries the blood to both lungs where it will receive oxygen. In the lungs, the arteries branch into ever smaller tubes, eventually pushing the blood through tiny vessels called [capillaries](https://www.wisegeek.com/what-are-capillaries.htm).. The blood cells, in turn, drop waste carbon dioxide into the lungs, allowing it to be exhaled

b)THE CIRCLE OF WILLIS: The circle of Willis gets its name from the physician Thomas Willis, who [described](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC539424/) this part of the anatomy in 1664. The circle of Willis is a part of the [cerebral circulation](https://en.wikipedia.org/wiki/Cerebral_circulation) and is composed of the following arteries :[Anterior cerebral artery](https://en.wikipedia.org/wiki/Anterior_cerebral_artery) ,artery, Internal [Posterior cerebral artery](https://en.wikipedia.org/wiki/Posterior_cerebral_artery) ,[Posterior communicating artery](https://en.wikipedia.org/wiki/Posterior_communicating_artery). The [middle cerebral arteries](https://en.wikipedia.org/wiki/Middle_cerebral_arteries), supplying the brain, are not considered part of the circle of Willis.

### Origin of arteries

The left and right internal carotid arteries arise from the left and right common carotid arteries. The posterior communicating artery is given off as a branch of the internal carotid artery just before it divides into its terminal branches - the anterior and middle cerebral arteries. The anterior cerebral artery forms the anterolateral portion of the circle of Willis, while the middle cerebral artery does not contribute to the circle.

All arteries involved give off cortical and central branches. If one part of the circle becomes blocked or narrowed ([stenosed](https://en.wikipedia.org/wiki/Stenosis)) or one of the arteries supplying the circle is blocked or narrowed, blood flow from the other [blood vessels](https://en.wikipedia.org/wiki/Blood_vessel) can often preserve the cerebral perfusion well enough to avoid the symptoms of [ischemia](https://en.wikipedia.org/wiki/Ischemia).The circle of Willis is an important junction of arteries at the base of the brain. The structure encircles the middle area of the brain, including the stalk of the pituitary gland and other important structures.

Function: It allows for proper blood flow from the arteries to both the front and back hemispheres of the brain. The circle of Willis also serves as a sort of safety mechanism when it comes to blood flow. If a blockage or narrowing slows or prevents the blood flow in a connected artery, the change in pressure can cause blood to flow forward or backward in the circle of Willis to compensate.

This mechanism could also help blood flow from one side of the brain to the other in a situation in which the arteries on one side have reduced blood flow. In an emergency, such as a stroke, this may reduce the damage or aftereffects of the event.

Importantly, the circle of Willis does not actively carry out the function. Instead, the natural shape of the circle and the way that pressure acts in the area simply allow for bidirectional blood flow when necessary

C) SPLANCHNIC CIRCULATION: The splanchnic circulation consists of the blood supply to the gastrointestinal tract, liver, spleen, and pancreas. It consists of two large capillary beds partially in series. The small splanchnic arterial branches supply the capillary beds, and then the efferent venous blood flows into the PV. The splanchnic circulation sacrifices perfusion during periods of whole body stress in order to ensure adequate blood flow to other organs. Impaired regulation of splanchnic blood flow contributes to the pathophysiology of a variety of digestive diseases. The splanchnic circulation powerfully influences systemic arterial pressure via two distinct mechanisms. This has relatively little effect on total peripheral resistance but raises cardiac output and arterial pressure by increasing central blood volume and thus cardiac preload. Splanchnic sympathetic [nerve activity](https://www.sciencedirect.com/topics/neuroscience/nerve-conduction) is controlled by arterial and cardiopulmonary [baroreceptors](https://www.sciencedirect.com/topics/neuroscience/baroreceptor), and by inputs from other [somatic and visceral afferents](https://www.sciencedirect.com/topics/neuroscience/somatic-afferent). Some stimuli are able to alter SNA in a selective fashion. The circulation is a complex system. A number of important functions depend on its normal operation, including digestion and absorption within the gut, maintenance of the mucosal barrier, and successful healing of surgical anastomoses, but we have little quantitative information about its physiology because routine measurement in humans is so difficult. This article outlines some basic science and describes how influential the circulation might be in our clinical practice.It comprises three major branches of the abdominal aorta; the coeliac artery; superior mesenteric artery (SMA); and inferior mesenteric artery.

d)**Coronary circulation** is the [circulation of blood](https://en.wikipedia.org/wiki/Circulatory_system#Coronary_vessels) in the [blood vessels](https://en.wikipedia.org/wiki/Blood_vessel) that supply the [heart muscle](https://en.wikipedia.org/wiki/Cardiac_muscle) (myocardium). [Coronary arteries](https://en.wikipedia.org/wiki/Coronary_arteries) supply [oxygenated](https://en.wikipedia.org/wiki/Oxygen_saturation_%28medicine%29) blood to the heart muscle, and [cardiac veins](https://en.wikipedia.org/wiki/Coronary_circulation#Cardiac_veins) drain away the blood once it has been deoxygenated. Because the rest of the body, and most especially the [brain](https://en.wikipedia.org/wiki/Brain), needs a steady supply of oxygenated blood that is free of all but the slightest interruptions, the heart is required to function continuously. Therefore its circulation is of major importance not only to its own tissues but to the entire body and even the [level of consciousness](https://en.wikipedia.org/wiki/Level_of_consciousness) of the brain from moment to moment. Interruptions of coronary circulation quickly cause heart attacks ([myocardial infarctions](https://en.wikipedia.org/wiki/Myocardial_infarction)), in which the heart muscle is damaged by [oxygen starvation](https://en.wikipedia.org/wiki/Hypoxia_%28medical%29). Such interruptions are usually caused by ischemic heart disease ([coronary artery disease](https://en.wikipedia.org/wiki/Coronary_artery_disease)) and sometimes by [embolism](https://en.wikipedia.org/wiki/Embolism) from other causes like obstruction in blood flow through vessels

[Coronary arteries](https://en.wikipedia.org/wiki/Coronary_arteries) supply blood to the myocardium and other components of the heart. Two coronary arteries originate from the left side of the heart at the beginning (root) of the [aorta](https://en.wikipedia.org/wiki/Aorta), just after the aorta exits the [left ventricle](https://en.wikipedia.org/wiki/Left_ventricle). The left coronary artery distributes blood to the left side of the heart, the left atrium and ventricle, and the interventricular septum. The [circumflex artery](https://en.wikipedia.org/wiki/Circumflex_branch_of_left_coronary_artery) arises from the left coronary artery and follows the [coronary sulcus](https://en.wikipedia.org/wiki/Coronary_sulcus) to the left. Eventually, it will fuse with the small branches of the right coronary artery. The larger [anterior interventricular artery](https://en.wikipedia.org/wiki/Anterior_interventricular_artery), also known as the left anterior descending artery (LAD), is the second major branch arising from the left coronary artery. It follows the anterior interventricular sulcus around the pulmonary trunk. Along the way it gives rise to numerous smaller branches that interconnect with the branches of the [posterior interventricular artery](https://en.wikipedia.org/wiki/Posterior_interventricular_artery), forming [anastomoses](https://en.wikipedia.org/wiki/Anastomose). An anastomosis is an area where vessels unite to form interconnections that normally allow blood to circulate to a region even if there may be partial blockage in another branch. The anastomoses in the heart are very small. Therefore, this ability is somewhat restricted in the heart so a [coronary artery blockage](https://en.wikipedia.org/wiki/Coronary_artery_blockage) often results in [myocardial infarction](https://en.wikipedia.org/wiki/Myocardial_infarction) causing [death of the cells](https://en.wikipedia.org/wiki/Necrosis) supplied by the particular vessel.

e)CUTANEOUS CIRCULATION: The cutaneous circulation is the circulation and blood supply of the skin. The skin is not a very metabolically active tissue and has relatively small energy requirements, so its blood supply is different to that of other tissues. Some of the circulating blood volume in the skin will flow through will flow through **arteriovenous anastomoses (AVAs)** instead of capillaries. AVAs serve a role in temperature regulation. In this article we shall consider the different adaptations of the cutaneous circulation, and its role in body temperature control.

The skin is the body’s main heat dissipating surface: the amount of blood flow to the skin determines the degree of heat loss and therefore the core body temperature. The blood flow through AVAs is heavily influenced by the sympathetic nervous system.  At rest, the sympathetic nervous system dominates and acts to constrict AVAs.Any changes in core temperature are detected by the thermoregulatory centre in the hypothalamus. It regulates temperature by altering the level of sympathetic outflow to the cutaneous vessels, to return temperature to its normal range:

3)

During exercise, the job of the cardiovascular system is to deliver blood and oxygen from the heart and lungs to your working muscles. During a single bout of aerobic exercise, your cardiovascular system responds to meet the increased oxygen need of your muscles.The integrated response to severe exercise involves fourfold to fivefold increases in cardiac output, which are due primarily to increases in cardiac rate and to a lesser extent to augmentation of stroke volume. The increase in stroke volume is partly due to an increase in end-diastolic cardiac size (Frank-Starling mechanism) and secondarily due to a reduction in end-systolic cardiac size. The full role of the Frank-Starling mechanism is masked by the concomitant tachycardia. The reduction in end-systolic dimensions can be related to increased contractility, mediated by beta adrenergic stimulation. Beta adrenergic blockade prevents the inotropic response, the decrease in end-systolic dimensions, and approximately 50% of the tachycardia of exercise. The enhanced cardiac output is distributed preferentially to the exercising muscles including the heart.

When you start aerobic exercise, your body immediately senses a need for increased oxygen and starts taking steps to get more oxygen into your body and then delivered to your muscles. However, these physiological responses can take up to four minutes to rev up your metabolism in order to meet the new oxygen demands. During this time, your body is using your anaerobic systems to create energy. During the first few minutes of exercise, as your body tries to meet your new oxygen needs, you are in a state of oxygen deficit.

In order to meet oxygen and energy needs during aerobic exercise, and overcome your oxygen deficit, the cardiovascular system goes through some changes from your normal resting state. Your cardiac output is influenced by your heart rate and stroke volume. Stroke volume is the amount of blood that is pumped out of your heart with each beat. Both your heart rate and stroke volume increase during exercise which increases your cardiac output. Your respiration, or breathing rate, is also increased to bring more oxygen to your lungs.

During exercise, your systolic blood pressure also increases and plays an important role in your blood distribution. Some of your blood vessels can contract or relax. The vessels that deliver blood to active tissues during exercise, such as your muscles, will actually dilate. This allows more blood to flow to your muscles. During exercise, less blood is needed in organs such as your stomach and intestines, and therefore, some of those blood vessels will constrict.

When you stop exercising, although your oxygen requirement goes back to your resting level, your cardiovascular system takes some time to get back to normal. While your respiration, blood pressure and cardiac output will slowly decrease, they all remain above resting levels during a recovery period in order to remove exercise byproducts such as lactic acid from your blood and restore your normal conditions. This elevated state of metabolism is referred to as excess post-exercise oxygen consumption. The higher the intensity of your exercise, the greater the after effect your body will have.