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Chapter 13 SQ3R – Cardiovascular System

13.1 The Blood Vessels

What are the three types of blood vessels and how do they differ? In what direction is blood traveling in each?
The three types of blood vessels are arteries, capillaries, and veins. Arteries carry blood away from the heart to the capillaries, whereas veins carry blood from the capillaries to the heart. Capillaries, which are thin blood vessels, act as the medium which permits exchange of material with the tissues of an organism. Arteries are made up of smaller components known as arterioles as are veins (which are called venules).

In what type of blood vessel does exchange take place?

Exchange of material (such as waste and nutrients) takes place in capillaries as they serve the cells of the organism.

13.2 The Heart

The right side of the heart pumps blood to what body area? The left side of the heart pumps blood to what body area?

The right side of the heart pumps blood to the lungs to filter the O_2-poor blood (rid of CO_2 and adds oxygen) whereas the left side of the heart pumps blood to the rest of the body so as to provide nourishment (it contains O_2-rich blood).

What is the path of blood through the heart?

O_2-poor blood from the superior and inferior vena cava (originating from the upper and lower extremities of the body) enter the right atrium where it is sent through an atrioventricular valve (the tricuspid valve) to the right ventricle. Here blood is channelled through the pulmonary semi-lunar valve through the pulmonary trunk and to the pulmonary arteries where the blood is then taken to the lungs. At the lungs 4 pulmonary veins carry O_2-rich blood to the left atrium and sends it through another atrioventricular valve (the biscupid or mitral valve) to the left ventricle and finally through the aortic semilunar valve into the aorta where it is distributed to the rest of the body.

13.3 The Vascular Pathways

What specific blood vessels carry O_2-poor blood from the heart to the lungs? What specific blood vessels carry O_2-rich blood from the lungs to the heart?

The pulmonary circuit deals with taking blood from and to the heart and lungs. The pulmonary arteries take O_2-poor blood from the heart to the lungs whereas the pulmonary veins take O_2-rich blood from the lungs to the heart.

What circuit is responsible for blood transport to most of the body? Which chamber of the heart pumps blood to the body? Blood from the body returns to which heart chamber?

The systemic circuit is responsible for blood transport to most of the body. The left chamber (left ventricle) of the heart pumps heart to the body (O_2-rich) whereas the blood from the body returns to the right chamber (right atrium) of the body (O_2-poor).

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What are the major blood vessels of the body?

The major blood vessels of the body are as follows:
Veins: Internal jugular vein, external jugular vein, subclavian vein, superior vena cava, inferior vena cava, renal vein, common iliac vein, mesenteric vein, femoral vein, and the great saphenous vein.
Arteries: Subclavian artery, common carotid artery, aorta, renal artery, mesenteric artery, common iliac artery, femoral artery.

13.4 Blood

What are the components of blood and what are their functions?

Blood consists of formed elements and plasma. Within the formed elements you have red blood cells that function to transport O_2 and help transport CO_2, white blood cells that fight infection and platelets that aid clotting. Plasma consists of mainly water which functions to maintain blood volume and transport molecules, plasma proteins which maintain blood osmotic pressure & pH, salts that also aid metabolism, gases that aid cellular respiration, nutrients that supply food for cells, and nitrogenous wastes to be excreted by the kidneys.

In general, what steps result in a blood clot?

First a blood vessel in the body needs to be damaged. From here platelets clump at the site of the puncture and partially seal the leak, releasing a clotting factor called prothrombin activator and eventually allow long threads of fibrin to form around the platelet plug in the damaged area of the blood vessel to provide the framework for the clot. This fibrin clot is present temporarily until blood vessel repair is initiated and the enzyme plasmin destroys the fibrin network to restore the fluidity of the plasma.

Where and how are materials exchanged between blood and tissue fluid?

Materials are exchanged between blood and tissue fluid within capillaries. It is done with the help of osmotic pressure (from salts and plasma proteins) which tends to cause water to move from tissue fluid to the blood and blood pressure which causes water to move in the opposite direction. At the arterial end of a capillary blood pressure outweighs the osmotic pressure and thus this is where water exits. In the middle of the capillary where the BP is lower, two forces essential cancel each other out allowing for no net movement of water. Solutes diffuse according to their concentration gradient (nutrients like glucose and oxygen diffuse out of the capillary whereas waste like carbon dioxide diffuses in). These substances that leave the capillary contribute to tissue fluid (the fluid between the body's cells) which contains all components of plasma (with lesser amounts of protein). The venous end of a capillary, as you'd expect, is where you have osmotic pressure greater than BP and thus you have water moving into the capillary (enough to virtually cancel out the amount that left). However, some excess tissue fluid is always collected by the lymphatic capillaries and stored as lymph which is later returned to the system venous blood when the major lymphatic cessels enter the subclavian veins.

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13.5 Cardiovascular Disorders

What are some common disorders associated with the cardiovascular system?

Some common disorders associated with the cardiovascular system are atherosclerosis (accumulation of soft masses of fatty materials beneath the inner linings of arteries – plaque), stroke (bursting of blockage of small cranial arteriole by an embolus), heart attack (occurs when a portion of the heart muscle dies due to lack of oxygen), aneurysm (bursting of a blood vessel). Stroke, heart attacks, and aneurysms are associated with both atherosclerosis and hypertension (high blood pressure).

Testing Yourself

1. **Both the right side and the left side of the heart**
   B. Consist of an atrium and ventricle.
2. **Systole refers to the contraction of the**
   C. Atria and ventricles
3. **During a heartbeat,**
   B. First the atria contract and then the ventricles contract.
4. **The first heart sound, the 'lub' of the 'lub-dup' sound, is caused by**
   B. The closing of the atrioventricular valves.
5. **The T wave of an ECG represents**
   D. Recovery following ventricular contraction.
6. **Blood leaving the right ventricle will move through pulmonary arteries, then to the lungs for gas exchange. Which blood vessel was omitted?**
   A. Pulmonary trunk
7. **Systemic arteries carry blood**
   E. Both a and d are correct.
8. **Which of these does not correctly contrast the pulmonary circuit and the systemic circuit?**
   C.
9. **The blood vessel which carries absorbed materials from the digestive system to the liver is the**
   D. Hepatic portal vein.
10. **The best explanation for the slow movement of blood in capillaries is**
    C. There are many more capillaries than arterioles.
11. **Which of the following assists in the return of venous blood to the heart?**
    E. All of these are correct.
12. **Which association is incorrect?**
    B. Red blood cells – blood clotting
13. **Blood clotting does not involve which of the following?**
    E. Leukocytes
14. **The last step in blood clotting**
    E. Converts fibrinogen to fibrin.
15. **Water enters the venous side of the capillaries because of**
    D. Higher blood pressure on the arterial side.

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16. **Which illness has been linked to hypertension?**
    E. All of these are correct.
17. **Label this diagram of the heart**
    A. Aorta B. LeftPulmonary Arteries C. Pulmonary Trunk D. Left Pulmonary Veins
    E. Left Atrium F. Semilunar Valves G. Atrioventricular (mitral) Valve
    H. Left Ventricle I. Septum J. Inferior Vena Cava K. Right Ventricle
    L. Chordae Tendineae M. Atioventricular (tricuspid) Valve N. Right Atrium
    O. Right Pulmonary Veins P. Right Pulmonary Artery Q. Superior Vena Cava

e-Learning

1. **How are large blood vessels nourished with oxygen and nutrients?**
   Large blood vessels have tiny blood vessels of their own that carry oxygen and nutrients to the vessel wall.
2. **What determines whether blood flows into one particular capillary bed or another?**
   Blood flow into capillary beds is regulated by a precapillary sphincter that allows blood to flow into capillaries when open or forces blood into an arteriovenous shunt when closed.
3. **Give one example of how the heart can be used to illustrate the relationship between structure and function.**
   The thick structure of the left ventricle compared to the thinner left demonstrates the relationship between structure and function as the left side works harder than the right since it focuses on pumping blood throughout the body and back, whereas the right pump solely delivers blood to the lungs and back to the heart.
4. **Does the heart quit beating if the SA node fails?**
   The AV node also generates impulses to contract, so although the heart does not beat as rapidly when the SA node fails, it continues to beat.
5. **What is a portal system? Give an example of one in the human body.**
   A portal system begins and ends with a bed of capillaries. An example of one in the human body is the hepatic portal system that carries blood from the small intestine to the liver rather than into general circulation.
6. **Is arterial blood pressure constant throughout the body?**
   Blood pressure is not constant throughout the body but instead decreases with distance from the left ventricle.
7. **What is the primary function of red blood cells and white blood cells?**
   Red blood cells contain hemoglobin and function to distribute oxygen throughout the body. The various types of white blood cells participate in defending the body against disease.
8. **What portions of the blood participate in clotting?**
   Blood clotting involves two plasma proteins, prothrombin and fibrinogen, along with platelets.
9. **What are the two primary disorders that lead to stroke, heart attack, and aneurysm?**
   Hypertension and atherosclerosis may lead to stroke, heart attack, and aneurysm.
10. **What are the recommendations for maintaining a healthy cardiovascular system?**
    A heart-healthy diet, regular exercise, proper weight, and not smoking are recommended for a healthy cardiovascular system.