Human physiology and nutritional biochemistry

Respiratory system

Components of transport of oxygen and carbon dioxide, role of hemoglobin in transport, mechanism of respiration, chloride shift, bohr`s effect.

Exchange of oxygen and carbon dioxide

The gaseous exchange obtained in lungs contains branched structure of bronchi and alveoli. During respiration continual supply of oxygen and to continuous removal of carbon dioxide was obtained. The exchange of gases occurs between alveolar air and pulmonary blood capillaries by the process of simple diffusion. The partial pressure plays a vital role in respiration the oxygen and carbon di oxide can be diffuse from higher to lower partial pressure. There are two types of gaseous exchange pulmonary and systemic gaseous exchange. In systemic gas exchange, the exchange of gases occurs between systemic blood capillaries and tissue cells. In pulmonary gas exchange obtained between alveolar and capillaries epithelial cells.

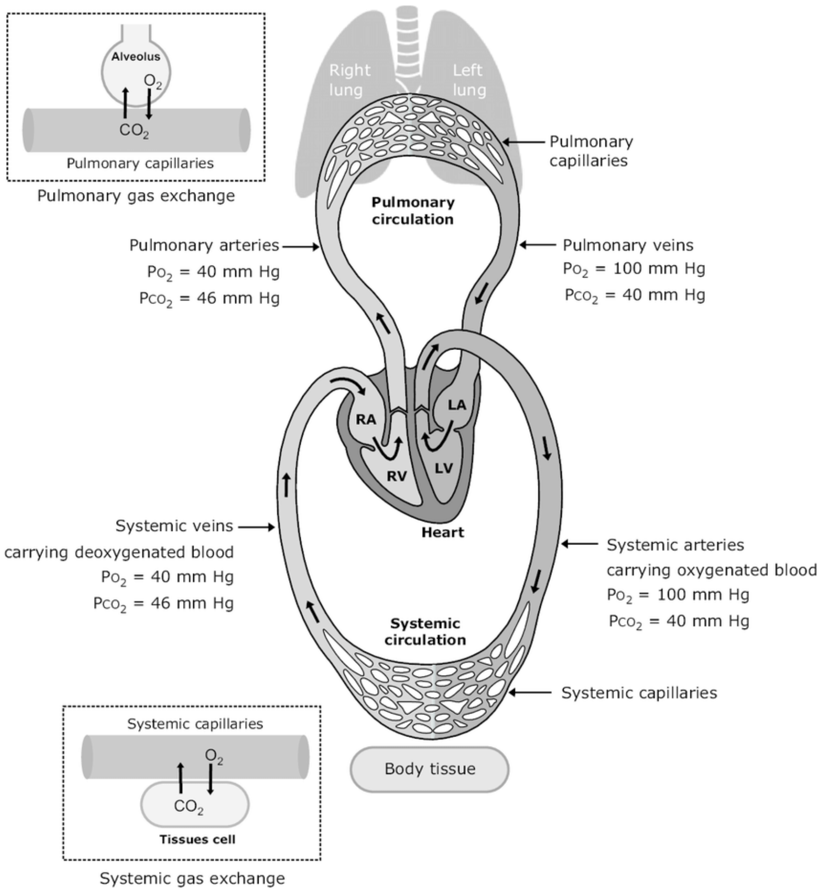

Fig exchange of gases

Source

https://www.researchgate.net/profile/Usha_Mina/publication/310995415/figure/fig23/AS:433360720928768@1480332655051/Oxygen-and-carbon-dioxide-exchange-across-pulmonary-and-systemic-capillaries-caused-by.png

The blood passes through the lungs, takes oxygen and gives up carbon dioxide by simple diffusion down partial pressure gradients between blood and alveoli. When blood flows through the pulmonary capillaries, it is exposed to alveolar air with partial pressure at 100 mm Hg is higher than the PO_2 of 40 mm Hg in the blood entering the lungs, oxygen diffuses down its partial pressure gradient from the alveoli into the blood until no further gradient exists.

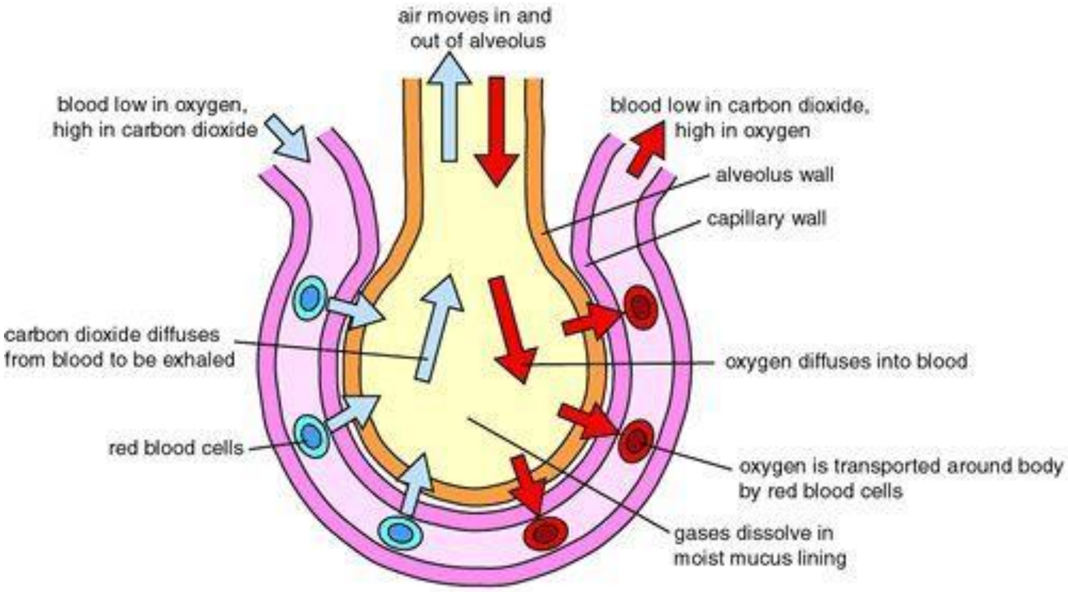

Fig: pulmonary gas exchange

Source https://i.pinimg.com/564x/e5/a0/ea/e5a0eaa5e7d6fa93d0371a39a436a7a2.jpg

Haemoglobin

Hemoglobin is made up of four polypeptide chain composed to two alpha and beta chain each chain is made up of 141 and 146 amino acids, with molecular weight of 65,000 with prosthetic group of heme. Hemoglobin carries oxygen from lungs to tissues and carbon dioxide from tissues to lungs. Heme has iron, which is linked to the imidazole nitrogen of the histidine in positions 58 and 87 of the alpha chains. In the beta chain the heme iron is linked with histidine in positions 92 and 63. Each molecule of haemoglobin can carry four molecules of oxygen.

Composition of Haemoglobin

Heme

The prosthetic group make a packet like structure by folding of hemoglobin, an iron porphyrin ring.

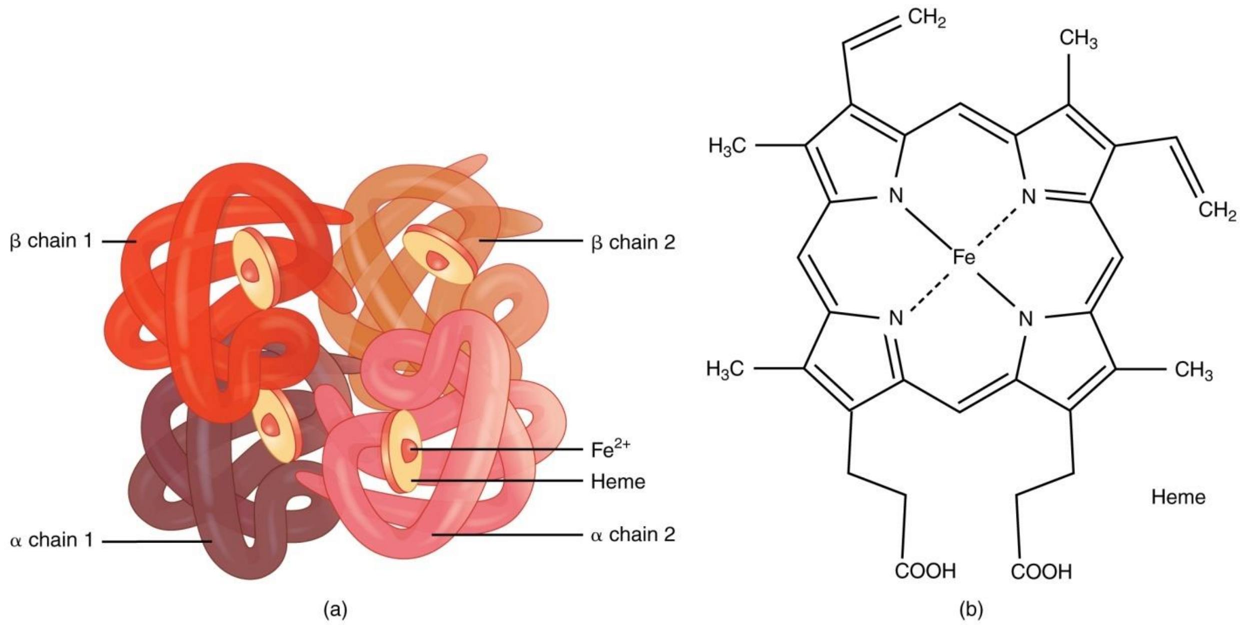

Fig Structure of haemoglobin

Source https://upload.wikimedia.org/wikipedia/commons/9/91/1904_Hemoglobin.jpg

Porphyrin

Porphyrin is a complex compound with a tetrapyrrole ring structure. On the basis of presence of functional group in porphyrins (methyl, acetyl, propyl, butyl or venyl) types of porphyrins are identified, that will be seen during the synthesis of heme.

Biosynthesis of heme

Heme is an iron porphyrin structure, synthesized in the reticuloendothelial cells (bone marrow) of adult human being. Erythropoietin produced in kidney stimulates the formation, maturation and release of erythrocytes by bone marrow. Early stage of erythrocyte cells contain porphyrin, during the course of their development, porphyrin is converted to heme by addition of iron and then to hemoglobin by addition of protein, globin. The type of porphyrin present in heme is protoporphyrin-III (also known as No. IX).

It is synthesized starting from glycine and succinyl-CoA. Given below is the diagrammatic representation of biosynthesis of Heme where ‘A’ stands for acetyl group, ‘P’ stands for propyl group, ‘M’ for methyl group, and ‘V’ for venyl group

3.2. The various hemoglobin derivatives are

Oxyhaemoglobin (HbO_2)

The main function of hemoglobin is to transport oxygen from the lung to the tissues. In lungs the partial pressure of oxygen is 100 mm of Hg, at this pressure hemoglobin is 95-96% saturated with oxygen. On binding with O_2 in the lungs hemoglobin is converted to oxy-hemoglobin.

Carbaminohaemoglobin

Hemoglobin binds to carbon di oxide in the tissues. carbon di oxide is bound to the α-amino group at the N-terminal end of each of the four polypeptide chains of hemoglobin to form carbaminohemoglobin.

Methemoglobin

In RBC the iron of hemoglobin is normally in ferrous (Fe^{2+}) form, but it is readily oxidized to the ferric (Fe^{3+}) form by hydrogen peroxide. Met-hemoglobin is dark brown in colour. The percent of met-hemoglobin can increase if the person consumes drugs like ferricyanide, nitrite, quinines, hydroxylamine's, acetanilide and sulfonamide. The symptoms are cyanosis and dyspnoea. Met-hemoglobin can be used to overcome cyanide poisoning. By injecting met-hemoglobin it combines with cyanide to form cyanomethemoglobin preventing cyanide poisoning.

Carboxyhaemoglobin

Hemoglobin can bind to carbon monoxide (CO) which have has got an affinity of 200 times more than that of O_2 towards Hb. The oxygen binding capacity is reduced and there is also reduced leads to tissue hypoxia and patients show cherry red colour of skin. CO poisoning can be treated if high amount of O_2 is provided continuously at high pressure.

There are three types of hemoglobin's that are normally found in human beings, they are

HbA

Found in normal adult human beings – contains 2α and 2β chains.

HbA_2

Found in some human beings and is considered normal — contains 2α and 2β chains.

HbF

Foetal hemoglobin — found in growing foetus — contains 2α and 2ɣ chains.

Alpha chain is synthesized from alpha genes of hemoglobin, beta chain from beta genes of hemoglobin likewise y and eight from their respective genes. There are two pairs of a genes but only one pair each of beta, gama and delta genes. Defect in α genes and some are with defective β chains leads to disease conditions.

Biochemistry of Abnormality in the Haemoglobin

HbS or Sickle Cell Haemoglobin

Sickle cell hemoglobin (HbS) arises due to the defect in β chain in which glutamic acid present at the 6^{th} position is replaced by valine. These two valine residues form hydrophobic interaction producing a sticky patch. Causes reduced life span, unstable, hemolysis leads to anemia The precipitate formed in the RBC sinks down and the biconcave shape of RBC is converted to sickle shape.

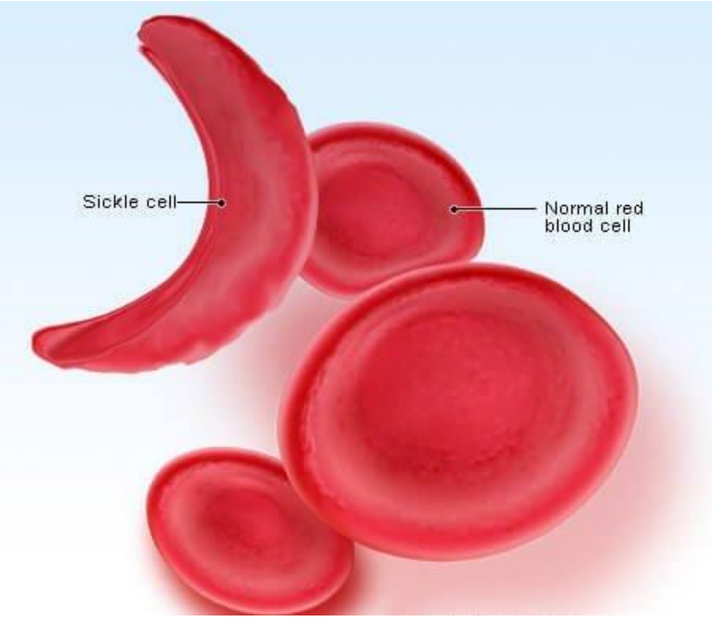

Fig Sickle Cell Haemoglobin

Source https://images.medicinenet.com/images/illustrations/sickl_cell.jpg

HbM or Methemoglobin

This is due to replacement of histidine residue in 58th position in α chain and 63rd position in β chain. Due to this eplacement, ferrous is oxidized to ferric. This ferric iron cannot bind oxygen. Therefore the oxygen carrying capacity is disrupted leading to anemia and hypoxia.

Thalassemia's

An inherited disease due to decreased rate of synthesis of one of the polypeptide chains of the globin molecule.

There are two types of thalassemia

β-thalassemia

Due to the decreased synthesis rate of P-chain of globin leads to β-thalassemia . a-chains either combine among themselves forming a-4-globin or it can combine with γ or δ chains, thereby forming more of HbA2 and HbF resulting in hypoxia. The life span of such RBC is greatly reduced.

α-thalassemia

Due to decreased synthesis of alpha chain in globlin leads to alpha thalassemia it is an rare disorder due to lack of a chain, the β chain may combine either with δ, γ or among itself forming β_4, or $\beta_2\delta_2$ or $\beta_2\gamma_2$.

Glucose-6-Phosphate Dehydrogenase Deficiency

It is an X-linked recessive hereditary disease. Glucose-6-phosphate dehydrogenase is an enzyme in the pentose phosphate pathway, a metabolic pathway that supplies reducing energy to cells by maintaining the level of the co-enzyme nicotinamide adenine dinucleotide phosphate. Glucose-6-phosphate dehydrogenase converts glucose-6-phosphate into 6-phosphogluconate and is the rate- limiting enzyme of the pentose phosphate pathway..

Due to lack in enzyme Glucose-6-phosphate dehydrogenase deficiency are at risk of hemolytic anemia in states of oxidative stress. Deficiency of Glucose-6-phosphate in the alternative pathway causes the build-up of glucose and thus there is an increase of advanced glycation end products. The deficiency also causes a reduction of NADPH which is necessary for the formation of Nitric Oxide. The high prevalence of diabetes mellitus type two and hypertension in Afro-Caribbean's in the West could be directly related to Glucose-6-phosphate deficiency.

Pyruvate Kinase Deficiency

It is an inherited autosomal recessive genetic disorder due to lowered production, activity, or stability of pyruvate kinase. It is due deficiency in the enzyme pyruvate kinase.

In pyruvate kinase deficiency, the last step in glycolysis an initial step in metabolic pathyway of ATP synthesis due to lack of enzyme pyruvate kinase the production of ATP decreased and the unable to maintain the activity of the basolateral Na^+/K^+-ATPase leads to increased intracellular sodium and water diffuse passively into RBC leads to swelling. The build-up of reaction intermediates can also increase the level of 2, 3-bisphosphoglycerate (2,3BPG) in the cells and affect tissue oxygenation.

Reference

1. Animal physiology and Biochemistry- RA Agarval, Anil. K, Srivastava, Kausshal Kumar, S. Chand & Co.
2. Life science, fundamental and practice by Usha meena and Pranav kumar

THE CIRCULATORY SYSTEM

Most of the cells in the human body are not in direct contact with the external environment, so rely on the circulatory system to act as a transport service for them. Two fluids move through the circulatory system: blood and lymph. The blood, heart, and blood vessels form the Cardiovascular System. The lymph, lymph nodes and lymph vessels form the Lymphatic System. The Cardiovascular System and the Lymphatic System collectively make up the Circulatory System.

1. Vertebrates have a closed circulatory system, meaning the blood is repeatedly cycled throughout the body inside a system of pipes.

2. It was in 1628, when the English Dr. William Harvey showed that blood circulated throughout the body in oneway vessels. According to him, blood was pumped out of the heart and into the tissues through one type of vessel and back to the heart through another type of vessel. The blood, in other words, moved in a closed cycle through the body.

3. Blood is the body's internal transportation system. Pumped by the heart, blood travels through a network of blood vessels, carrying nutrients ($O2$, glucose) and hormones to the cells and removing waste products ($CO2$. urea) from the 1012 (= 100 trillion) cells of our bodies..

THE HEART

1. The central organ of the cardiovascular system is the heart. This is a hollow, muscular organ that contracts at regular intervals, forcing blood through the circulatory system.

2. The heart is cone-shaped, about the size of a fist, and is located in the centre of the thorax, between the lungs, directly behind the sternum (breastbone). The heart is tilted so that the base is tilted to the left.

3. The walls of the heart are made up of three layers of tissue: a) The outer and inner layers are epithelial tissue. b) The middle layer, comprising the cardiac muscle of the heart itself, is called the myocardium.

4. For obvious reasons, the cardiac muscle is not under the conscious control of the nervous system, and can generate its own electrical rhythm (myogenic). For the same reasons, cardiac muscle cannot respire anaerobically and so the muscle cannot get tired (or develop cramp!)

5. Cardiac muscle has a rich supply of blood, which ensures that it gets plenty of oxygen. This is brought to the heart through the coronary artery. Since the heart relies on aerobic respiration to supply its energy needs, cardiac muscle cells are richly supplied with mitochondria.

6. Our hearts beat about once every second of every day of our lives, or over 2.5 million times in an average life span. The only time the heart gets a rest is between beats.

HOW THE HEART WORKS

1. The heart can be thought of as two pumps sitting side by side – each of which has an upper atrium and a lower ventricle – a total of 4 chambers. It functions as two pumps inside one.

2. The right side of the heart pumps 'deoxygenated blood' (actually, blood low in oxygen) from the body into the lungs, where gas exchange takes place. In that process, carbon dioxide

is lost to the air and oxygen is absorbed. This oxygen is almost all carried by the Red Blood Cells (RBC's).

3. The left side of the heart pumps oxygenated blood from the lungs to the rest of the body.

4. The heart is enclosed in a protective membrane-like sac called the pericardium, which surrounds the heart and secretes a fluid that reduces friction as the heart beats.

5. The atria (upper chambers) of the heart receive blood coming into the heart. Then have thin walls, so allowing them to be filled easily. They pump the blood into the ventricles (lower chambers), thus filling them.

6. The ventricles pump blood out of the heart and the left ventricle has the thickest walls of the heart because it has to do most of the work to pump blood to all parts of the body. This is where the blood has the highest pressure.

7. Vertically dividing the two sides of the heart is a wall, known as the septum. The septum prevents the mixing of oxygenated (left side) and deoxygenated (right side) blood.

8. It also carries electrical signals instructing the ventricles when to contract. These impulses pass down specially-modified muscle cells (Purkinje fibres), collectively known as the Bundle of His.

THE RIGHT SIDE OF THE HEART

1. Deoxygenated blood from the body enters the right side of the heart through two large veins called the vena cavae. The superior vena cava returns blood from the head and arms; the inferior vena cava from the rest of the body (except, of course, the lungs!)

2. Both empty into the right atrium. This is where the blood pressure is lowest (even negative). When the heart relaxes (between beats), pressure in the circulatory system causes the right atrium to fill with blood.

3. When the atria contract, pressure inside it rises, the right atrioventricular (AV) valve opens, and blood is squeezed from the right atrium into the right ventricle. This valve is also known as the tricuspid valve. The closing of this valve makes a sound – 'lub'.

4. When the atrium is empty, the pressure inside it falls, and the pressure inside the ventricle begins to rise. This causes the atrio-ventricular valve to Atria contract shut quickly, preventing the back-flow of blood.

5. The general purpose of all valves in the circulatory Ventricles contract system is to prevent the back-flow of blood, ry arteries, where it goes to the lungs. These are the t. The closing of these valves also causes a sound – up'. A normal heart-beat is thus 'lub…dup'. e es when the atrium is empty and pressure e aorta, which carries ta to p shut, as the elastic walls of the aorta recoil, thus preventing back-flow of blood into the heart. and so ensure that blood flows in only one direction.

6. When the right ventricle contracts, blood is forced out through the semi-lunar valve (also known as the pulmonary valve), into the pulmona only arteries to carry deoxygenated blood.

7. When the right ventricle is empty, the pressure inside falls below that in the pulmonary artery, and this causes the semi-lunar valve to snap shu 'd

THE LEFT SIDE OF THE HEART

1. Oxygenated blood leaves the lungs and returns to the heart through th pulmonary veins. These are the only veins to carry oxygenated blood.

2. This blood enters the left atrium, which, when full, forces blood into the left ventricle, filling it. The valve which opens is called the left atrioventricular (AV) valve, (or bicuspid or mitral valve). As on the right side of the heart, this valve clos begins to rise in the ventricle.

3. From the left ventricle, blood is forced at very high pressure through another semi-lunar valve (the aortic valve), into th blood throughout the body (apart from the lungs!).

4. This surge of blood from the ventricles causes the walls of the aor expand and the muscles within to stretch – we can detect this as a pulse.

5. When the ventricle is almost empty, the pressure begins to fall below that in the aorta, and this causes the semi-lunar valve to sna

THE CARDIAC CYCLE

1. The cardiac cycle is the sequence of events in one heartbeat. In its simplest form, the cardiac cycle is the simultaneous contraction of both atria, followed a fraction of a second later by the simultaneous contraction of both ventricles.

2. The heart consists of cardiac muscle cells that connect with each other – they are branched – and so when one contracts, they stimulate their neighbours and they all contract. The heart is an ‘all-ornothing’ muscle, getting its rest between beats. It can only respire aerobically.

3. A heartbeat has two phases: A. Phase 1 - Systole is the term for contraction. This occurs when the ventricles contract, closing the A-V valves and opening the Semi-Lunar valves to pump blood into the two major vessels leaving the heart. B. Phase 2 – Diastole is the term for relaxation. This occurs when the ventricles relax, allowing the back pressure of the blood to close the semi-lunar valves and opening the A-V valves.

4. The cardiac cycle also creates the heart sounds: each heartbeat produces two sounds, often called lub-dup, that can be heard with a stethoscope. The first sound is caused by the contraction of the ventricles (ventricular systole) closing the A-V valves. The second sound is caused by the snapping shut of the Aortic and Pulmonary Valves (Semi-lunar valves). If any of the valves do not close properly, an extra sound called a heart murmur may be heard.

5. Although the heart is a single muscle, it does not contract all at once. The contraction spreads over the heart like a wave, beginning in a small region of specialized cells in the right atrium called the Sino-Atrial Node (SAN). This is the hearts natural pacemaker, and it initiates each beat

6. The impulse spreads from the SAN through the cardiac muscle of the right and left atrium, causing both atria to contract almost simultaneously.

7. When the impulse reaches another special area of the heart, right in the centre of the septum, known as the AtrioVentricular (or AV) Node, the impulse is delayed for approximately 0.2 s. This allows time for the ventricles to fill completely.

8. The AV Node relays the electrical impulse down the septum, along the Bundle of His, to the base of the ventricles. The ventricles then contract simultaneously, from the bottom upwards, thus allowing them to empty completely with each beat.

9. The heartbeat is initiated by the Sino-Atrial Node and passes through the Atrio-Ventricular Node, remaining at the same rhythm until nerve impulses cause it to speed up or to slow down. Unlike other muscles, it does not require a new nerve impulse for each contraction.

10. The autonomic nervous system controls heart rate. The accelerator nerve of the sympathetic nervous system increases heart rate and the vagus nerve of the parasympathetic nervous system decreases heart rate. 11. For most people, their resting heart rate is between 60 and 80 b.p.m. During exercise that can increase to as many as 200 beats per minute for an athlete; for the rest of us, 150 b.p.m. is about all we can safely manage.

BLOOD VESSELS (ARTERIES, VEINS and CAPILLARIES)

1.The Circulatory System is known as a closed system because the blood is contained within either the heart or blood vessels at all times – always flowing in one direction. The path is the same – heart (ventricles) → arteries → arterioles → organ (capillaries) → veins → heart (atrium)
2. Except for the capillaries, all blood vessels have walls made of 3 layers of tissue. This provides for both strength and elasticity:
A. The inner layer is made of epithelial tissue.
B. The middle layer is smooth muscle.
C. The outer layer is connective tissue.

ARTERIES and ARTERIOLES

1. Arteries carry blood from the heart to the capillaries of the organs in the body. 2. The walls of arteries are thicker than those of veins. The smooth muscle and elastic fibres that make up their walls enable them to withstand the high pressure of blood as it is pumped from the heart. The force that blood exerts on the walls of blood vessels is known as blood pressure and it cycles with each heart-beat (see below).
3. Each artery expands when the pulse of blood passes through and the elastic recoil of the fibres cause it to spring back afterwards, thus helping the blood along. This is known as secondary circulation, and it reduces the load on the heart.
4. Other than the pulmonary arteries, all arteries carry oxygenated blood
5. The aorta carries oxygenated blood from the left ventricle to all parts of the body except the lungs. It has the largest diameter (25mm) and carries blood at the highest pressure.
6. As the aorta travels away from the heart, it branches into smaller arteries so that all parts of the body are supplied. The smallest of these are called arterioles.
7. Arterioles can dilate or constrict to alter their diameter and so alter the flow of blood through the organ supplied by that arteriole. Examples include muscles (when running) and skin (when hot or blushing). Since the volume of blood remains the same, if more blood flows through one organ, less must flow through another.
8. Two organs which always have the same blood flow are the brain and the kidneys. Popular organs to have blood flow reduced are the guts (between meals), muscles (when resting) and skin (when cold).

CAPILLARIES

1. Arterioles branch into networks of very small blood vessels – the capillaries. These have a very large surface area and thin walls that are only one (epithelial) cell thick.
2. It is in the capillaries that exchanges take place between the blood and the tissues of the body.
3. Capillaries are also narrow. This slows the blood down allowing time for diffusion to take occur. In most capillaries, blood cells must flow in single file.
4. Tissue fluid is formed in the capillaries, for their walls are leaky (see below).

VEINS

1. After leaving the capillaries, the blood enters a network of small venules, which feed into veins. These, in turn, carry the blood back to the atria of the heart.
2. Like arteries, the walls of veins are lined with epithelium and contain smooth muscle. The walls of veins are thinner and less elastic than arteries, but they are also more flexible.
3. Veins tend to run between the muscle blocks of the body and nearer to the surface than arteries.
4. The larger veins contain valves that maintain the direction of blood-flow. This is important where blood must flow against the force of gravity.
5. The flow of blood in veins is helped by contractions of the skeletal muscles, especially those in the arms and legs. When muscles contract they squeeze against the veins and help to force the blood back towards the heart. Once again, this is known as secondary circulation.

PATTERNS OF CIRCULATION

1. Blood moves through the body in a continuous fashion: Left ventricle → systemic circulation (body) → right atrium → right ventricle → pulmonary circulation (lungs) → left atrium → left ventricle.
2. Deoxygenated blood is pumped from the right ventricle into the lungs through the pulmonary arteries – the only arteries to carry deoxygenated blood.
3. Blood returns to the heart through the pulmonary veins, the only veins to carry oxygenated blood.
4. The systemic circulation starts at the left ventricle and ends at the right atrium. It carries blood to and from the rest of the body.
5. The heart itself receives its supply of blood from the two coronary arteries leading from the aorta. Blood enters into capillaries that lead to veins through which blood returns to the right atrium.
6. There are three parts of the systemic circulation that you need to know:

A. coronary circulation - supplying blood to the heart muscle (coronary artery).
B. renal circulation – supplying blood to the kidneys (renal artery). Nearly 25% of the blood leaving the heart flows to the kidneys, which are pressure filters for waste.
C. hepatic portal circulation- nutrients picked up by capillaries in the small intestines are transported directly to the liver in the hepatic portal vein, where excess nutrients are stored. This is about 70% of the liver's blood supply. The liver also receives oxygenated blood from the hepatic artery, which branches off the aorta, and provides 30% of its blood. All blood leaves the liver through the hepatic vein.

BLOOD PRESSURE

1. Blood moves through our circulation system because it is under pressure, caused by the contraction of the heart and by the muscles that surround our blood vessels. The measure of this force is blood pressure.
2. Blood pressure will always be highest in the two main arteries, just outside the heart, but, because the pulmonary circulation is inaccessible, blood pressure is measured in the systemic circulation only, i.e. blood leaving the left ventricle only – normally in the upper arm.
3: To measure blood pressure:
a) Ensure the patient is relaxed and has not taken any exercise for at least 10 mins.
b) A cuff is inflated around a persons arm - stopping the flow of blood through the artery.
c) The pressure in the cuff is slowly released – whilst listening for the first sounds of blood passing through the artery. This means that the ventricles are pumping with enough force to overcome the pressure exerted by the cuff. This is the systolic pressure.
d) Normal systolic pressure is about 120 mm Hg for males; 110mm Hg for females. Average systolic pressure rises with age so 100+ your age is a safe maximum.
e) The pressure continues to be released – now listening for the disappearance of sound - indicating a steady flow of blood. This is the diastolic pressure, when the pressure of the blood is sufficient to keep the arteries open even when the ventricles relax.
f) Normal diastolic pressure is about 80 mm Hg for males and 70 mm Hg for females.
g) Blood pressure readings are given as two numbers – the systolic (higher) figure over the diastolic (lower) figure e.g. 120/80mm Hg.
h) Hypertension (high blood pressure) is diagnosed when the diastolic pressure is >10mm Hg above the norm; the systolic pressure is of less concern.

Blood pressure is maintained by:

a) The kidneys, which regulate blood pressure by removing excess water (and salt) from the body. The higher the blood pressure, the more water is forced out in the nephrons; this reduces the volume of lymph and lowers the blood pressure. But it makes the blood thicker (thus more likely to clot).
b) The nervous system, which regulates heart rate. The level of CO_2 in the blood is monitored in the carotid artery and the aorta and this information is sent to the cardiovascular centre in the brain. This sends impulses down either the accelerator nerve (of the sympathetic nervous system), which speeds up heart rate, or down the vagus nerve (of the parasympathetic nervous system), which slows it down. Both nerves lead to the sino-atrial node (SAN). c) Stretch receptors in the walls of the heart. When exercising, more blood is returned to the heart, causing the walls to stretch more than normal. The heart responds to this by beating faster and harder.
5) Blood pressure that is too high (risk of thrombosis) or too low (risk of fainting) are undesirable.

Electrocardiogram (ECG)

An electrocardiogram records the electrical signals in your heart. It's a common and painless test used to quickly detect heart problems and monitor your heart's health.

Electrocardiograms — also called ECGs or EKGs — are often done in a doctor's office, a clinic or a hospital room. ECG machines are standard equipment in operating rooms and ambulances. Some personal devices, such as smart watches, offer ECG monitoring. Ask your doctor if this is an option for you

Types

Holter monitor

Implantable loop recorder

Why it's done

An electrocardiogram is a painless, noninvasive way to help diagnose many common heart problems in people of all ages. Your doctor may use an electrocardiogram to determine or detect:

- Abnormal heart rhythm (arrhythmias)
- If blocked or narrowed arteries in your heart (coronary artery disease) are causing chest pain or a heart attack
- Whether you have had a previous heart attack
- How well certain heart disease treatments, such as a pacemaker, are working

You may need an ECG if you have any of the following signs and symptoms:

- Chest pain
- Dizziness, lightheadedness or confusion
- Heart palpitations
- Rapid pulse
- Shortness of breath
- Weakness, fatigue or a decline in ability to exercise

The American Heart Association doesn't recommend using electrocardiograms to assess adults at low risk who don't have symptoms. But if you have a family history of heart disease, your doctor may suggest an electrocardiogram as a screening test, even if you have no symptoms.

If your symptoms tend to come and go, they may not be captured during a standard ECG recording. In this case your doctor may recommend remote or continuous ECG monitoring. There are several different types.

- **Holter monitor.** A Holter monitor is a small, wearable device that records a continuous ECG, usually for 24 to 48 hours.
- **Event monitor.** This portable device is similar to a Holter monitor, but it records only at certain times for a few minutes at a time. You can wear it longer than a Holter monitor, typically 30 days. You generally push a button when you feel symptoms. Some devices automatically record when an abnormal rhythm is detected.

Reference
1.© IHW October 2005