Chapter -18

BODY FLUIDS AND CIRCULATION

POINTS TO REMEMBER

Blood: A special connective tissue that circulates in principal vascular system of man and other vertebrates consisting of fluid matrix, plasma and formed elements.

Plasma: The liquid part of blood or lymph which is straw coloured, viscous fluid and contains about 90-92% of water and 6-8% proteins.

Lymph: A clear yellowish, slightly alkaline, coagulable fluid, containing white blood cells in a liquid resembling blood plasma.

Heart Beat: The rhythmic contraction and relaxation of the heart, which includes one systole (contraction phase) and one diastole (relaxation phase) of the heart. Heart beat count of healthy person is 72 times per minute.

Cardiac output: The amount of blood pumped by heart per minute is called cardiac or heart output. The value of cardiac output of a normal person is about 72×70 = 5040 mL or about 5L per minute.

Electrocardiograph: (ECG) The machine used to record electrocardiogram.

Electrocardiogram ECG: The graphic record of the electric current produced by the excitation of the cardiac muscles. It is composed of a ‘P’ wave, ‘QRS’ wave (complex) and ‘T’ wave (Refer fig. 18.3, page 286 (for a standard ECG) (NCERT class XI - Biology)

Human Blood Corpuscles

<table>
<thead>
<tr>
<th>Name and Number/Percentage</th>
<th>Structure</th>
<th>Life Span and Formation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Erythrocytes RBCs - 4.5 to 5.5 million per cubic millimetre of blood</td>
<td>Yellow colour Circular, biconcave denucleated, elastic, lack of cell organelles like ER, ribosomes, mitochondria etc.</td>
<td>Formed from birth onwards by bone marrow Life - 120 days</td>
<td>Transport of oxygen and some amount of carbon dioxide.</td>
</tr>
<tr>
<td>Type</td>
<td>Colour</td>
<td>Origin</td>
<td>Life Span</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td>---------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>(B) Leucocytes (WBCs)</td>
<td>Colourless, rounded or irregular, nucleated 12 to 20um wide</td>
<td>Formed in bone marrow, Lymph nodes spleen and thymus</td>
<td>Acts as soldiers, scavenger and some help in healing</td>
</tr>
<tr>
<td>(i) Agranulocytes</td>
<td>Large rounded nucleus</td>
<td>Lymph nodes, spleen, thymus bone marrow, life few days to months or even years</td>
<td>Non Phagocytic secrete antibodies</td>
</tr>
<tr>
<td>(a) Lymphocytes</td>
<td>Largest of all bean shaped nucleus</td>
<td>Bone marrow, life 10-20 hours</td>
<td>phagocytic, engulf germs</td>
</tr>
<tr>
<td>(b) Monocytes</td>
<td>Many lobed nucleus fine granules</td>
<td>Bone marrow, life 4 to 8 hours in blood</td>
<td>play role in immunity nonphagocytic release heparin and histamin</td>
</tr>
<tr>
<td>(c) Neutrophils</td>
<td>Many lobed nucleus fine granules</td>
<td>Bone marrow, life 4 to 8 hours in blood</td>
<td>phagocytic, engulf germ and dead cells help in blood clotting</td>
</tr>
<tr>
<td>(ii) Granulocytes</td>
<td>Three lobed nucleus</td>
<td>Bone marrow, life 4 to 8 hours in blood</td>
<td></td>
</tr>
<tr>
<td>(a) Eosinophils</td>
<td>Bilobed nucleus, granules in cytoplasm</td>
<td>Bone marrow</td>
<td></td>
</tr>
<tr>
<td>(b) Basophils</td>
<td>Three lobed nucleus</td>
<td>Bone marrow, life 4 to 8 hours in blood</td>
<td></td>
</tr>
<tr>
<td>(C) Platelets thrombocytes</td>
<td>Colourless, rounded or oval, non nucleated fragments of cell</td>
<td>Bone marrow about a week</td>
<td></td>
</tr>
</tbody>
</table>

Refer fig. 18.1, page 279 (NECRT Class XI - Biology)
Lymph

The colourless mobile fluid connective tissue drains into the lymphatic capillaries from the intercellular spaces.

Composition:

It is composed of fluid matrix, plasma, white blood corpuscles or leucocytes.

Functions:

(i) It drains excess tissue fluid from extra cellular spaces back into the blood.
(ii) It contain lymphocytes and antibodies.
(iii) It transport digested fats.

Human Heart

It is the mesodermally derived organ situated in thoracic cavity in between the two lungs. Protected by pericardium.

- Four chambers - two (left and right) atria, and two ventricles (left and right)
- Inner- atrial septum separates the two atria and inter ventricular septum separates the two ventricles, while the atria & ventricles are separated by atrio-ventricular septum.
- The valves between right atrium and right ventricle is tricuspid while between left atrium and ventricle is bicuspid or mitral value.
- The openings of the right and the left ventricles into the pulmonary artery and the aorta are guarded by semilunar values.
- The valves allow the flow of blood only in one direction, i.e., from atria to ventricles and from ventricles to pulmonary artery or aorta.

Blood Clotting

Injured Tissue Releases

Thromboplastins

\[ Ca^{++} \text{Proteins} \]

Prothrombinase

Inactivates heparin and catalyses

Prothrombinn

\[ Ca^{++} \]

Thrombin

Catalyses

Fibrinogen

(Fibrin + Blood cells)

Clot

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Blood Groups

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Antigen (on the Surface of RBCs)</th>
<th>Anti body (In plasma)</th>
<th>Possible recipients having blood group</th>
<th>Prospective donors having blood group</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>Anti B</td>
<td>A, AB</td>
<td>O, A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Anti A</td>
<td>B, AB</td>
<td>O, B</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>A and B</td>
<td>None</td>
<td>AB</td>
<td>O, A, B, AB</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>None</td>
<td>Anti A and anti B</td>
<td>O, A, B, AB</td>
<td>O</td>
<td>Donor</td>
</tr>
</tbody>
</table>

Rh (Rhesus) System:

Discovered by Landsteiner and wiener in 1940. The antigen found on the surface of RBCs. The presence of this antigen is termed as Rh - positive (Rh+) and its absence as (Rh−)

→ SAN (Sino - arterial node): A patch of tissues present in the right upper corner of the right atrium.

→ AVN (Atrio Ventricular Node): A mass of tissues seen in the lower left corner of the right atrium close to the atrio-ventricular septum.

Heart Valves

Tricuspid Valve: The valves formed of three muscular flaps or cups, which guard the opeing between the right atrium and the right ventricle.

Bicuspid Valve (Mirtral Valve):

The valves which guard the opeing between the left atrium and the left ventricle, made up of two flaps.

Semilunar Valves: The valves present at the opeing of the right and the left ventricles and allow the entry of blood into pulmonary artery and the aorta respectively.

Reading of ECG: ‘P’ Wave represents the electrical excitation (or depolarisation) of the atria and leads to the contraction of both the atria.

‘ORS’ complex: represents the depolarisation of the ventricles, which imitates the ventricular contraction

‘T’ Wave: represents the return of the ventricles from excited to normal state (repolarisation). The end of T-wave marks the end of sytole.

Double circulation: The passage of same blood twice through heart in order to complete one cycle. eg.
(i) The blood pumped by the right ventricle (dioxygenated blood) is transported through pulmonary artery to lungs where CO₂ is exchanged with O₂ through diffusion and returns back to the heart through pulmonary vein.

(ii) The oxygenated blood from left ventricle is transported through aorta to different body parts (cells and tissues) where O₂ is exchanged with CO₂ through diffusion and then returned back to the heart through vena-cava.

**Disorders of circulatory System**

**Hypertension (High Blood Pressure)**: It results from narrowing of arterial lumen and reduced elasticity of arterial walls in old age. It can cause rupturing of capillaries. It is a silent killer.

**Coronary Artery Disease**: (CAD) Atherosclerosis The supply of the blood to heart muscles is affected. It is caused by deposits of calcium, fat, cholesterol and fibrous tissues to make the lumen of arteries narrower.

**Angina Pectoris**: Caused due to arteriosclerosis, when no enough oxygen is reaching the heart muscle due to which the person experiences acute chest pain.

**Heart attack**: Caused when the heart muscle is suddenly damaged by an inadequate blood supply.

**Cardiac arrest**: The state in which the heart stops beating.

**Arteriosclerosis**: The state of hardening of arteries and arterioles due to thickening of the fibrous tissue and consequent loss of elasticity. It causes hypertension.

**QUESTIONS**

**Very Short Answer Questions (1 mark each)**

1. Name the instrument used for measuring blood pressure.

2. What is a pace-maker?

3. Why is the S.A. node called pace-maker of the heart?

4. Write the full form of S.A. node.

5. What is lymph node?

6. A cardiologist observed an enlarged QR wave in the ECG of a patient. What does it indicate?

7. Name the enzyme that catalyses the formation of carbonic acid in erythrocytes.

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8. What is systemic circulation?
9. Give two examples of extra-cellular fluids.
10. What name is given to the blood vessels which generally bring blood to an organ?
11. Which adrenal hormone accelerates the heart beat under normal conditions.
12. Name the blood vessel that carries blood from the intestine to liver.
13. Define cardiac cycle.

Short Answer Questions-II (2 marks each)
14. Explain when and how the two sounds of heart are produced?
15. Define joint diastole. What are the constituents of the conducting system of human heart.
16. Give the names of various types of formed elements present in the blood.

Short Answer Questions-I (3 marks each)
17. Draw a diagram showing schematic plan of blood circulation in human.
18. In the following diagram of section of a human heart label a, b, c, d, e and f.

![Diagram of Heart](image)


Long Answer Questions (5 marks each)
20. Draw a diagram to show the internal structure of human heart. Label any two heart chambers, any two heart valves and chordae tendinae in it.
21. Describe the structure of human heart.
22. What is cardiac cycle? Describe the event that occur during it.
23. Explain Rh grouping and its incompatibility in humans.

**ANSWERS**

**Very Short Answers (1 mark)**

1. Sphygmomanometer.
2. A patch of modified heart muscle that imitates a wave of contraction.
3. S.A. node being self excitatory, initiates a wave of contraction in the heart.
4. Sinu auricular node (pace-maker)
5. A lymph node is specialised structure in lymphatic vessel concerned with the filtration of foreign bodies by the lymphocytes.
6. QR wave denotes ventricular contraction of heart which may be normal or abnormal.
7. Carbonic anhydrase.
8. The kind of blood circulation that is concerned with the supply of oxygenated blood from the left ventricle to all body parts and return of oxygenated blood to the right atrium of heart.
9. Interstitial fluid and blood plasma.
10. Afferent blood vessel.
11. Noradrenalin.
13. A regular sequence of three events (i) auricular systole (ii) ventricular systole and (iii) Joint diastole during the completion of one heart beat.

**Short Answers - II (2 marks)**

14. (i) ‘Lubb’ the first sound which is low pitched is caused by the closure of bicuspid and tricuspid valves.
   (ii) ‘Dup’ the second sound which is high pitched is caused by the closure of semilunar valves.
15. In a cardiac cycle when both atria and ventricles are in a diastole and are relaxed simultaneously is called a joint diastole.
Conducting system constitutes: SA node → AV node → Bundle of His → Purkinje fibres.

16. Erythrocytes, Lymphocytes, monocytes, neutrophils, eosinophils, basophils and platelets.

Short Answers -I (3 marks)
17. Refer fig. 18.4, page 287 (NCERT - Class XI - Biology)
18. Refer fig. 18.2, page 283 (NCERT - Class XI - Biology)
19. Refer content 18.2, page 282 (NCERT - Class XI - Biology)

Long Answer (5 marks)
20. Refer fig. 18.2, page 283 (NCERT - Class XI - Biology)
21. Refer content 18.3.1, page 283 (NCERT - Class XI - Biology)
22. Refer content 18.3.2, page 284 (NCERT - Class XI - Biology)
23. Refer content 18.1.3.2, page 281 (NCERT - Class XI - Biology)