RADIOLOGY SEC B PHYSIOLOGY, 2ND SEMESTER

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Attempt all questions. Every question carry 10 marks.

Q1. Write the functions and composition of blood?

Ans.

Functions of blood

Blood has three main functions: transport, protection and regulation.

Transport

Blood transports the following substances:

- *Gases, namely oxygen (O_2) and carbon dioxide (CO_2), between the lungs and rest of the body*
- *Nutrients from the digestive tract and storage sites to the rest of the body*
- *Waste products to be detoxified or removed by the liver and kidneys*
- *Hormones from the glands in which they are produced to their target cells*
- *Heat to the skin so as to help regulate body temperature*

Protection

Blood has several roles in inflammation:

- *Leukocytes, or white blood cells, destroy invading microorganisms and cancer cells*
- *Antibodies and other proteins destroy pathogenic substances*
- *Platelet factors initiate blood clotting and help minimise blood loss*

Regulation

Blood helps regulate:

- *pH by interacting with acids and bases*

- *Water balance by transferring water to and from tissues*

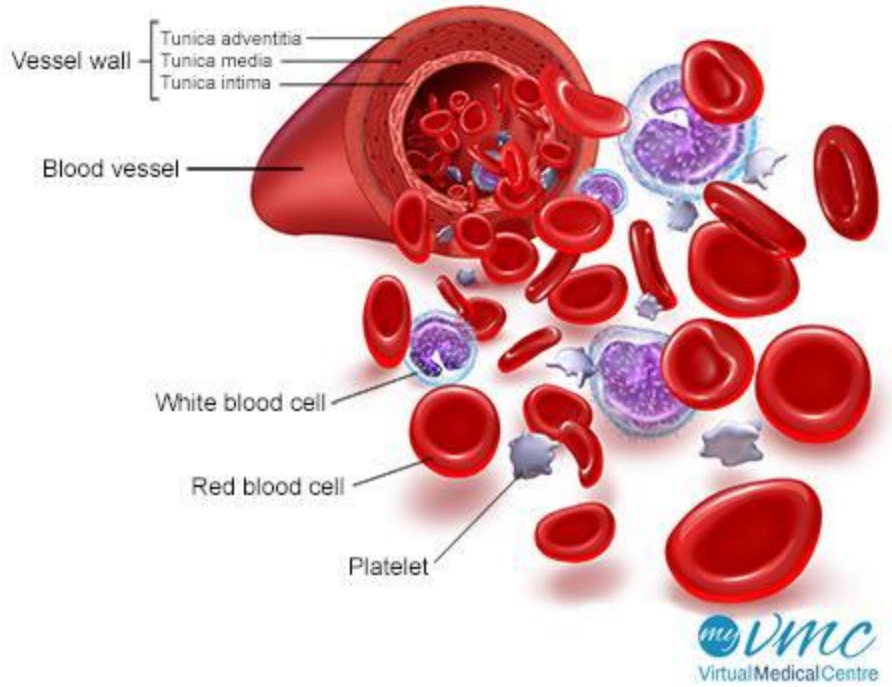
Composition of blood

Blood is classified as a connective tissue and consists of two main components:

1. *Plasma, which is a clear extracellular fluid*
2. *Formed elements, which are made up of the blood cells and platelets*
   The formed elements are so named because they are enclosed in a plasma membrane and have a definite structure and shape. All formed elements are cells except for the platelets, which are tiny fragments of bone marrow cells.

Formed elements are:

- *Erythrocytes, also known as red blood cells (RBCs)*
- *Leukocytes, also known as white blood cells (WBCs)*
- *Platelets, thrombocytes.*



Q2. What is erythrocyte, erythropoiesis, erythrocytosis and erythropenia?

Ans:

Erythrocyte:

- *A type of blood cell that is made in the bone marrow and found in the blood.*
- *Erythrocytes contain a protein called hemoglobin, which carries oxygen from the lungs to all parts of the body.*
- *Checking the number of erythrocytes in the blood is usually part of a complete blood cell (CBC) test.*
- *It may be used to look for conditions such as anemia, dehydration, malnutrition.*
- *Also called RBC and red blood cell.*

Erythropoiesis:

- *Production of red cells or erythropoiesis, is a tightly regulated process by which hematopoietic stem cells differentiate into erythroid progenitors and then mature into red cells.*
- *Erythropoiesis generates approximately 2×10^{11} new erythrocytes to replace the 2×10^{11} red cells removed from the circulation each day.*
- *Red cell production increases several fold after blood loss or hemolysis.*
- *When one of the progeny of the multipotential hematopoietic stem becomes committed to the erythroid lineage, this early erythroid progenitor undergoes a series of divisions and concurrent maturation that eventually result in morphologically recognizable erythroblasts.*
- *After expulsion of the nucleus, a macrocyte (polychromatophilic when stained by Wright stain, or a reticulocyte if stained with new methylene blue) leaves the marrow.*
- *During the first 24 hours in the circulation, reticulocytes lose their residual organelles (mitochondria and ribosomes) through an autophagic process and undergoes reconditioning of the membrane to become mature red blood cells with a morphology of a biconcave disc.*

Erythrocytosis:

- *Erythrocytosis is a condition in which your body makes too many red blood cells (RBCs), or erythrocytes.*
- *RBCs carry oxygen to your organs and tissues.*
- *Having too many of these cells can make your blood thicker than normal and lead to blood clots and other complications.*
- *There are two types of erythrocytosis:*
- *Primary erythrocytosis. This type is caused by a problem with cells in the bone marrow, where RBCs are produced. Primary erythrocytosis is sometimes inherited.*
- *Secondary erythrocytosis. A disease or the use of certain drugs can cause this type.*

Erytrocytopenia:

- *The presence of decreased numbers of erythrocytes in the blood, as occurs in some forms of anaemia*

Q3. What is platelets and write about clotting mechanism and its all steps?

Ans:

Platelets

- *are only about 20% of the diameter of red blood cells.*
- *The normal platelet count is 150,000-350,000 per microliter of blood, but since platelets are so small, they make up just a tiny fraction of the blood volume.*

- *The principal function of platelets is to prevent bleeding*

Platelet Production

- *Platelets are produced in the bone marrow, the same as the red cells and most of the white blood cells.*
- *Platelets are produced from very large bone marrow cells called megakaryocytes.*
- *As megakaryocytes develop into giant cells, they undergo a process of fragmentation that results in the release of over 1,000 platelets per megakaryocyte.*
- *The dominant hormone controlling megakaryocyte development is thrombopoietin (often abbreviated as TPO)*

Coagulation/ Clottng Mechanism

- *also known as clotting,*
- *is the process by which blood changes from a liquid to a gel, forming a blood clot.*
- *The mechanism of coagulation involves activation, adhesion and aggregation of platelets, as well as deposition and maturation of fibrin.*
- *The multistep process of blood clot formation to stop bleeding is called coagulation.*
- *When the entire coagulation cascade works properly, blood holds together firmly at an injury site and bleeding stops.*
- *People who have a bleeding disorder, however, are unable to make strong clots quickly or at all.*

How a blood clot is made

- *The coagulation cascade is a complex chemical process that uses as many as 10 different proteins (called blood clotting factors or coagulation factors) found in plasma in the blood.*
- *Put simply, the clotting process changes blood from a liquid to a solid at the site of an injury.*
- *Here's how the process works:*

1. *Injury*
   A small tear in a blood vessel wall (for example, from a cut on the skin or an internal injury) causes bleeding.

2. *Vessel constriction*
   To control blood loss the blood vessel narrows (called constriction), thus limiting blood flow through the vessel.
3. *Platelet plug*
   In response to the injury, tiny cells in the blood called platelets are activated. The platelets stick to one another and to the wound site to form a plug. The protein von Willebrand factor (VWF) helps the platelets stick to each other and to the blood vessel wall.
4. *Fibrin clot*
   Next, clotting factor proteins trigger production of fibrin, a strong, strand-like substance that forms a fibrin clot, a mesh-like net that keeps the plug firm and stable. Over the next several days to weeks, the clot strengthens and then dissolves as the wounded blood vessel wall heals.

The coagulation factors are numbered in the order of their discovery. There are 13 numerals but only 12 factors. Factor VI was subsequently found to be part of another factor. The following are coagulation factors and their common names:

- *Factor I - fibrinogen*
- *Factor II - prothrombin*
- *Factor III - tissue thromboplastin (tissue factor)*
- *Factor IV - ionized calcium (Ca++)*
- *Factor V - labile factor or proaccelerin*
- *Factor VI - unassigned*
- *Factor VII - stable factor or proconvertin*
- *Factor VIII - antihemophilic factor*
- *Factor IX - plasma thromboplastin component, Christmas factor*
- *Factor X - Stuart-Prower factor*
- *Factor XI - plasma thromboplastin antecedent*
- *Factor XII - Hageman factor*
- *Factor XIII - fibrin-stabilizing factor*

Q4. Write a detail note on ABO system?

Ans:

ABO blood group:

- *The major human blood group system.*

- *The ABO type of a person depends on the presence or absence of two genes, A and B.*
- *These genes determine the configuration of the red blood cell surface.*
- *A person who has two A genes or an A and an O gene has red blood cells of type A.*
- *A person who has two B genes or one B and one O gene has red cells of type B.*
- *If the person has one A and one B gene, the red cells are type AB.*
- *If the person has neither the A nor the B gene, the red cells are type O.*
- *It is essential to match the ABO status of both donor and recipient in blood transfusions and organ transplants.*

Discovery of the ABO system:

In 1900 Karl Landsteiner reported a series of tests, which identified the ABO Blood Group System. In 1910 he won Nobel prize for medicine for this discovery. He mixed the serum and cells of all the researchers in his lab and found four different patterns of agglutination. From those studies he developed what we now know as Landsteiner's rules for the ABO Blood Group:

1. *A person does not have antibody to his own antigens*
2. *Each person has antibody to the antigen he lacks (only in the ABO system)*

1. *Below are the four blood groups and the antigens and the expected, naturally-occurring antibodies present.*

BLOOD GROUP	*ANTIGEN*	*ANTIBODY*
A	*A*	*anti-B*
B	*B*	*anti-A*
AB	*A and B*	*Neither*
O	*neither anti-A or anti-B*	*anti-A,B*

ABO Typing

ABO typing involves both antigen typing and antibody detection. The antigen typing is referred to as the forward typing and the antibody detection is the reverse typing

- *The forward typing determines antigens on patient's or donor's cells*
  a. Cells are tested with the antisera reagents anti-A, anti-B, (and in the case of donor cells anti-A,B)
  b. Reagents are either made from hyperimmunized human sources, or monoclonal antibodies.
  c. One advantages of the monoclonal antibodies are the antibody strength.
  d. Another advantage of monoclonals: human source reagents can transmit infectious disease (hepatitis).
- *Reverse typing determines antibodies in patient's or donor's serum or plasma*
  a. Serum tested with reagent A_1 cells and B cells
  b. Reverse grouping is also known as backtyping or serum confirmation

Q5.(i) A person fell down from a tree and become unconscious, with bleeding from head, what will you do as a first aid?

Ans:

- *are they responsive?*
- *Not responsive – are they breathing?*
- *They are breathing. Look closely how they have fallen and carefully put them into the recovery position to keep their airway clear*
- *They are not breathing: start CPR immediately and act according to your organisation's emergency policy. Request a defibrillator immediately if there is one available.*

- *If the person is responsive*
- *Talk to them. Try and ascertain how the accident happened and if there could be any medical cause such as a fit or stroke – do not stress them if they are confused*
- *Try and work out where it hurts most and look at them closely to see if there is any obvious bleeding, bruising or contorted limbs indicating a particular injury.*

- *If they are conscious and you think they may have fallen from a height or could have injured their neck or spine – Do not move them. Try and keep them as still as possible and discourage them from twisting. Phone an ambulance and calmly keep reassuring them until paramedics arrive.*
- *If you are aware of any bleeding apply firm pressure with a clean pad whilst awaiting the First Aid kit.*
- *If they start to show signs of clinical shock – lie them back and raise their legs and get medical help*

- *If there is no obvious injury or medical cause for the fall*
- *Carefully and very slowly help them into a sitting position – watch them carefully for any signs of pain, discomfort or dizziness*
- *With help, carefully assist them into a chair, or back to bed.*
- *Very carefully and reassuringly check them over completely to ensure that there is no unseen injury – this is particularly important with diabetics when they may not feel where they have hurt themselves.*
- *Monitor them carefully for the next 24 hours, inform their next of kin and fill in an accident form.*

(ii) you have to meet with your friend and you came to know he is covid positive, what precautionary measures will you take?

Ans:

- *close contact with one another (within about 6 feet).*
- *Through respiratory droplets produced when an infected person coughs, sneezes or talks*
- *Wash your hands often*
- *Avoid close contact*
- *Cover your mouth and nose with a cloth face cover*
- *Cover coughs and sneezes*
- *Monitor Your Health*

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