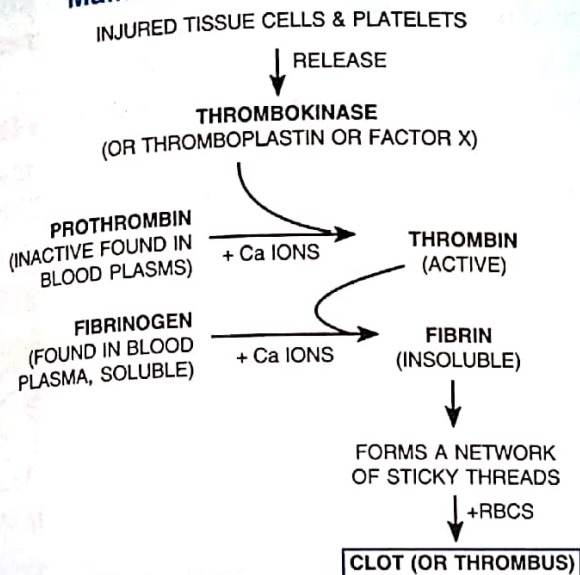
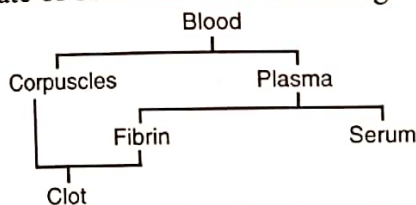


Main reactions in blood clotting



The fate of blood in blood clotting :



BLOOD CLOTTING IN A TEST-TUBE

If some blood is taken in a test-tube, a clot will form in the usual way and the serum squeezed out from the clot will collect on the surface (Fig. 8.5).

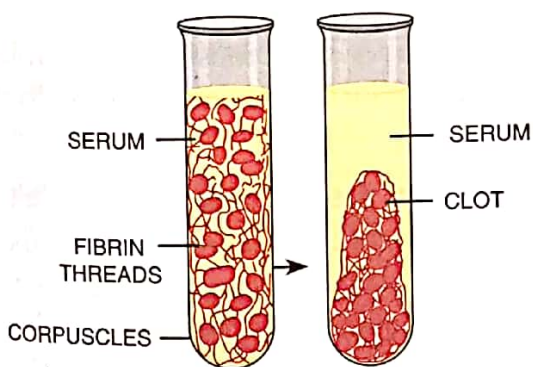


Fig. 8.5 Left, coagulated blood; the fresh clot consists of fibrin strands, corpuscles and serum. Right, coagulated blood after standing for some time; clot has separated from the serum. (Highly diagrammatic)

It is a wrong notion that clotting is dependent on the exposure of blood to air. In fact, clotting can be caused by the movement of blood over a rough surface as on cholesterol deposit on the inside of a blood vessel.

Read carefully.

Haemophilia is a genetic disorder in which blood does not clot properly due to lack of blood-clotting proteins. Also in cases where the **number of platelets** falls to an abnormally **low count**, coagulation occurs very slowly and often leads to haemorrhage. Such a situation occurs in certain diseases as in the **viral dengue fever** which has taken hundreds of lives in Delhi and other states of India since 1996 till date.

8.7 BLOOD TRANSFUSION AND BLOOD GROUPS (ABO and Rh systems)

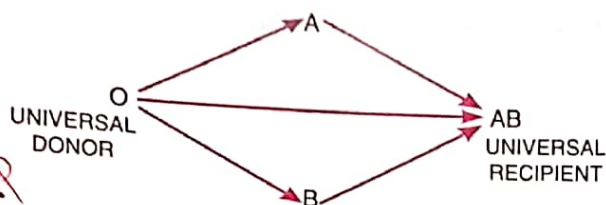
Sometimes it becomes necessary to inject blood into the body of patients undergoing surgical operation. This is called **blood-transfusion**. Blood taken from a healthy person (**donor**) is introduced through one of the patient's veins. But for doing so, it is necessary that the kind or the type of blood to be transfused should match (or be compatible) with the type of blood of the receiving person (**recipient**).

The concept of blood grouping was discovered by Karl Landsteiner. RBCs of human beings have specific proteins on their surface. These proteins are called **antigens**. In humans, there are two types of antigens : 1. **Antigen A** 2. **Antigen B**. The plasma of the blood contains complementary proteins, called **antibodies**, with respect to the antigen that is present on the surface of RBCs. Depending on the presence or absence of the type of antigens, there are four blood groups as shown in the table.

Blood group	Antigens on RBC	Antibodies in plasma
A	Antigen A	Antibody B
B	Antigen B	Antibody A
AB	Antigen A & B	No antibody
O	No antigen	Both antibody A and antibody B.

There are several systems of blood grouping. But two of them, **ABO system** and **Rh system** are most important.

ABO System : According to the ABO system, the human blood is classified into four types — A, B, AB and O. Besides the transfusion of one's own type of blood (A to A, AB to AB, etc.), the other possible transfusions can be made as follows :



Accordingly, O type blood can be given to persons of all types of blood i.e. to O, A, B & AB. Hence a person with O type is called **universal donor**. A person with AB type of blood can receive blood from all types, i.e., from AB, A, B & O, and is, therefore, called **universal recipient**. A person with A type can receive blood from A and O types and a person with B type from B and O types only.

The summary of matching (**compatibility**) and mismatching (**incompatibility**) in ABO system is given in the table below :

Table 8.2 Summary of ABO Blood Group matching (Compatibility)

Blood group of Donor	Blood group of Recipient			
	A	B	AB Universal recipient	O
A	✓	✗	✓	✗
B	✗	✓	✓	✗
AB	✗	✗	✓	✗
O Universal donor	✓	✓	✓	✓

Rh system : The blood of most people contains a substance called Rh factor. (Rh stands for Rhesus, our common monkey, in which the factor was first discovered). When the blood of such an individual (Rh-positive) is transfused into persons lacking it (Rh-negative), the blood of the recipient develops an antibody for Rh substance (gets sensitized) within about two weeks of transfusion. Now, if a second transfusion be given to such Rh-negative person, the antibody produced by the first transfusion causes a reaction with the transfused blood, which may even lead to death. This is similar to the development of an allergy.

Rh factor in pregnancy : An Rh-negative woman may become sensitive if she carries an Rh-positive child in her uterus (when the husband is Rh-positive). The first Rh-positive child will be normal, but if it

sensitizes the mother, the second positive child if conceived soon, may have a problem, sometimes leading to the death of foetus and abortion.

[Rh-positive may be written in short as Rh⁺ve or as Rh⁺ and similarly, the Rh-negative may be written as Rh⁻ve or as Rh⁻]. People with Rh⁺ blood group have D antigens on the surface of RBCs, while people with Rh⁻ blood group lack these antigens.



Progress Check



- State which of the following statements are True.
 - Process of coagulation starts with the release of a substance from RBCs.
 - Blood fails to clot readily in the case of deficiency of calcium.
 - The solid fibrin and thrombin are one and the same thing.
 - The clear liquid that oozes out after the formation of a clot is serum.
- Name the following :
 - The category of vitamin required for clotting of blood.
 - Any two diseases related with blood clotting.
 - The antibodies present in the plasma of O type blood group.
 - The animal for which Rh stands in the context of blood group.

8.8 BLOOD CIRCULATORY SYSTEM

The circulatory system consists of **heart, blood and blood vessels (arteries, veins and capillaries)**.

8.8.1 The Heart

Location (not on the left side, but it is felt so.)

The heart is right in the centre between the two lungs and above the diaphragm. The narrow end of the roughly triangular heart is pointed to the left side (Fig. 8.6) and during working, the contraction of the heart is most powerful at this end giving a feeling that the heart is on the left side.

Covering : The heart in adult humans is about the size of our closed fist – 12 cm in length and 9 cm in width. It is protected by a double walled membranous covering called **pericardium**. It contains lubricating pericardial fluid which reduces friction during heart beat and protects it from mechanical injuries.

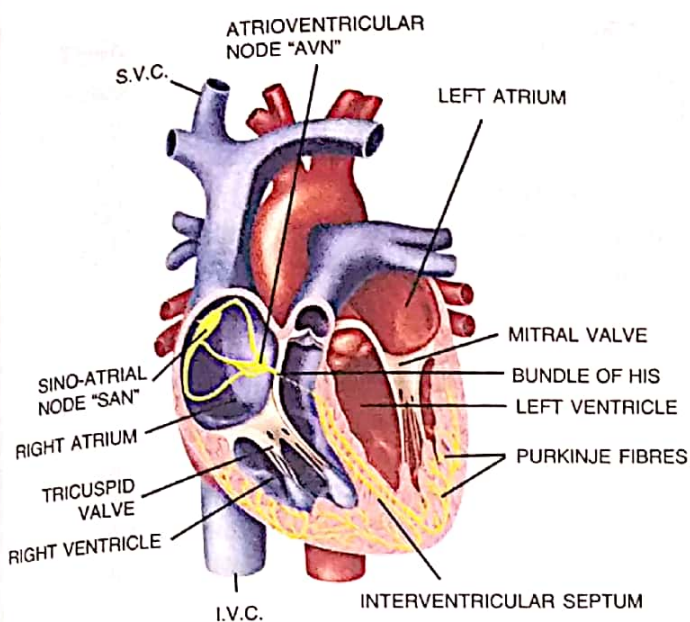


Fig. 8.9 : Internal structure of heart, showing location of "pacemaker" (SAN) and another contraction centre; "AVN" (atrioventricular node).

Sometimes the "pacemaker" becomes faulty causing heart trouble. An artificial "pace-maker" may be fixed in the heart of such a person.



Progress Check



- Name the following :
 - Contraction phase of heart.
 - The structure that holds the heart valves in position.
- Mention the phase of heart beat in which both the atrio-ventricular valves are closed.

8.8.7 The blood vessels

The blood vessels are branched tubes extending from the heart to all parts of the body. They are of three kinds – arteries, capillaries and veins.

An ARTERY is a vessel which carries blood away from the heart towards any organ.

Characteristics of an artery :

- thick muscular walls (Fig. 8.10),
- a narrow lumen (the central bore), and
- the blood in it flows in spurts which correspond to the ventricular contractions of the heart.

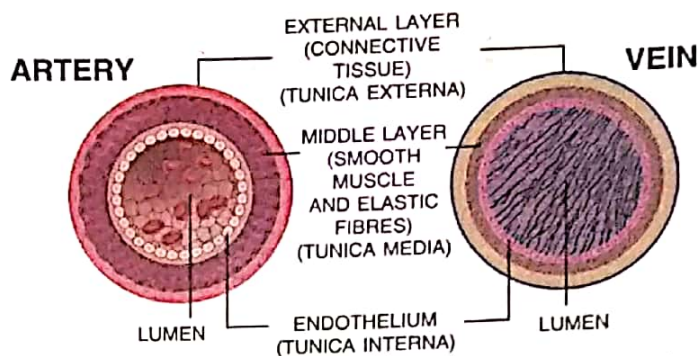


Fig. 8.10 : Structural difference between artery and vein

A VEIN is a vessel which carries the blood away from an organ towards the heart.

Characteristics of a vein :

- thin muscular walls,
- a wider lumen,
- the blood in it flows uniformly, and
- it contains thin pocket-shaped valves (Fig. 8.11) whose openings face in the direction of the heart. These valves prevent the backflow of the blood.

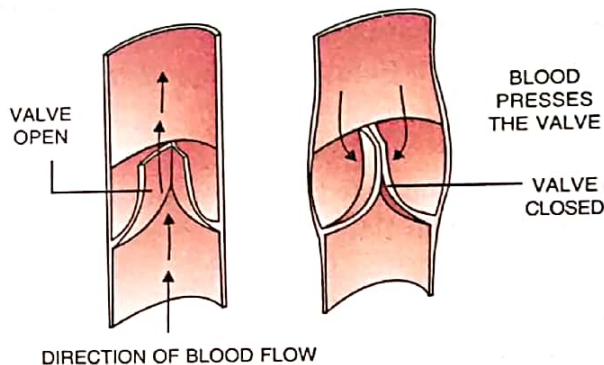


Fig. 8.11 : Valves in a vein regulate the flow of blood in the direction of the heart.

The smallest or the final branch of an artery is called an arteriole. Arterioles are highly muscular and can change their diameter manifold. The arteriole breaks up into capillaries (Fig. 8.12A).

A CAPILLARY is a very narrow tube (about 8 micrometres in diameter);

Characteristics of a capillary :

- its wall consists of a single layer of squamous epithelial cells (endothelium), and
- has no muscles (Fig. 8.12B). The total number of blood capillaries present in the whole body is almost inconceivable.

