

Blood clotting

Defn. A change of normal fluid state of blood into a jelly-like (semisolid) mass is known as Blood clotting / or Coagulation.

- It is the sole property of plasma, helped by Blood-platelets.
- The RBC & WBC do not take part in it.
- Clotting-time is about 4-5 minutes & Bleeding time is 2-6 minutes.

- Heparin prevents Blood clotting in blood vessel (vein)

Following theories have been proposed to explain the mechanism of Blood clotting.

1) Best & Taylor's theory :-

This is most-accepted theory. A/c to this theory Prothrombin, Ca⁺⁺, Thromboplastin, & fibrinogen are essential for Blood clotting. Clotting occurs in following steps-

- Thromboplastin or thrombokinase (tissue factor) is released by splitting / or cut platelets (coming in contact of air) or injured tissue
- Thromboplastin neutralizes Heparin (Anti-prothrombin)
- Inactive prothrombin is converted into active Thrombin or Thrombase by Thromboplastin & Ca⁺⁺.
- Thrombin converts soluble fibrinogen into insoluble fibrin.
- The fibrin networks traps / (entangles) blood corpuscles to form the clot.
- After sometime the fibres contract and an yellowish fluid comes out from the clot, known as Serum.

The entire process can be shown as follows - ↓

- Blood Platelets $\xrightarrow[\text{release}]{\text{in presence of air}}$ Thromboplastin
- Thromboplastin $\xrightarrow[\text{inactive}]{\text{makes}}$ Antithrombin
- Thromboplastin + Ca⁺⁺ + Prothrombin \rightarrow Thrombin
(Inactive)
- Thrombin + Fibrinogen \rightarrow Fibrin
(Soluble protein) (Insoluble protein)
- Fibrin + Blood cells \rightarrow Clot

(B) Howell's theory:

A/c to this theory, Coagulation of Blood inside Blood-vessel (BVS) is checked by Antithrombin.

- When a BVS is cut, tissue liberates Cephalin, which neutralises the effect of Antithrombin.
- Then Ca⁺⁺ reacts with Prothrombin & converts it to Thrombin.
- The Thrombin converts soluble fibrinogen present in the blood to insoluble fibrin to form Blood clot.

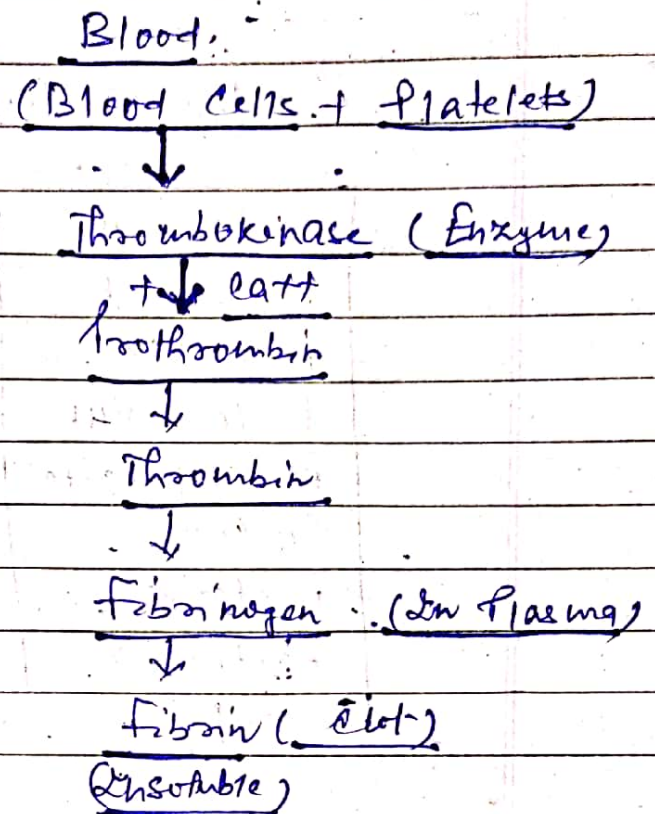
The entire process can be shown as following

- Tissue of Blood vessels \rightarrow Cephalin
- Cephalin \rightarrow makes Antithrombin (inactive)
- Prothrombin + Ca⁺⁺ \rightarrow Thrombin
- Thrombin + Fibrinogen \rightarrow Fibrin (Clot)
(Soluble) (Insoluble)

(C) Fuld & depeiro's theory

A/c to this theory, Blood clotting takes place in the following three steps:

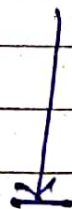
- An enzyme, Thrombokinase is produced by Blood platelets.
- Thrombokinase converts Prothrombin into Thrombin in presence of Ca⁺⁺.
- Thrombin converts fibrinogen into fibrin to form Blood clot.



Ⓓ Waterfall Hypothesis of E.W. Davie & O.D. Ratnoff (1965)
 According to this theory/hypothesis, the protein clotting factors of plasma exist in inactive form. These are activated sequentially until thrombin is formed. It then converts fibrinogen into fibrin. Such a sequence is referred to as the intrinsic clotting system.

Ⓔ Enzyme Cascade Hypothesis of Macfarlane (1964)
 It's very similar to the waterfall scheme of Davie & Ratnoff.

- The intrinsic & extrinsic Thromboplastin is formed in plasma & by injured tissue respectively.
- The overall clotting mechanism is as follows.



Surface Contact

Factor XII
Factor XI
Factor IX
Factor VIII
Platelet-factor
Calcium
Factor X
Factor V

Injured tissue

Calcium
Factor VII
Factor X
Factor V

Intrinsic Thromboplastin

Prothrombin

Extrinsic Thromboplastin

Thrombin

Factor XIII

Fibrinogen

Fibrin