HUMAN ANATOMY AND PHYSIOLOGY-1(BP101T)

UNIT: 3 BODY FLUIDS AND BLOOD

CLASS:4

TOPIC: MECHANISMS OF COAGULATION

Definition: Coagulation is the process by which blood changes from a liquid to a gel, forming a **blood clot** to prevent excessive bleeding when a blood vessel is injured

💉 Phases of Coagulation

The process occurs in **three major stages**:

1. Vascular Phase

- **Vasoconstriction** occurs immediately after injury to reduce blood flow.
- Initiated by reflex and local factors (e.g., endothelin released by endothelial cells).

2. Platelet Phase (Primary Hemostasis)

- **Platelet adhesion**: Platelets stick to exposed **collagen fibers** at the injury site via **von Willebrand factor (vWF)**.
- **Platelet activation**: Platelets change shape, release granules (ADP, thromboxane A2), and recruit more platelets.
- **Platelet aggregation**: Platelets form a temporary **platelet plug**.

◆ This forms a **temporary seal** but is not stable enough alone.

3. Coagulation Phase (Secondary Hemostasis)

This is the formation of a **stable fibrin clot** via a **cascade of clotting factors**.

🧪 **There are two main pathways that converge into a common pathway:**

🧩 **A. Intrinsic Pathway**

- Triggered by **damage inside** the vessel (e.g., exposed endothelium).
- Slower but more important for maintaining clotting.
- Involves **Factors XII, XI, IX, and VIII**.
- Activated by **negatively charged surfaces** (like collagen).

Steps:

1. Factor XII → XIIa
2. XIIa activates XI → XIa
3. XIa activates IX → IXa
4. IXa + VIIIa activates **Factor X**

🧩 **B. Extrinsic Pathway**

- Triggered by **external trauma** to the vessel.
- Faster response.
- Involves **Tissue Factor (Factor III)** and **Factor VII**.

Steps:

1. Tissue Factor (TF) released from damaged tissues
2. TF + Factor VII → VIIa
3. TF-VIIa complex activates **Factor X**

🧩 C. Common Pathway

- Both intrinsic and extrinsic pathways lead here.

Steps:

1. Factor X → Xa
2. Xa + Factor V = **Prothrombinase complex**
3. Converts **Prothrombin (Factor II) → Thrombin (IIa)**
4. Thrombin converts **Fibrinogen (Factor I) → Fibrin**
5. Fibrin forms a **mesh** that stabilizes the clot
6. **Factor XIIIa** cross-links fibrin strands = **stable clot**

Regulation and Inhibition

- **Antithrombin III**: Inhibits thrombin and Factors IXa, Xa
- **Protein C and Protein S**: Inactivate Factors Va and VIIIa
- **Tissue Factor Pathway Inhibitor (TFPI)**: Inhibits TF-VIIa complex
- **Plasmin**: Breaks down fibrin (fibrinolysis)

Clinical Relevance

- **Hemophilia A**: Deficiency of Factor VIII
- **Hemophilia B**: Deficiency of Factor IX
- **Vitamin K deficiency**: Affects synthesis of Factors II, VII, IX, X
- **Liver disease**: Impairs production of clotting factors
- **Warfarin & Heparin**: Anticoagulants that interfere with coagulation