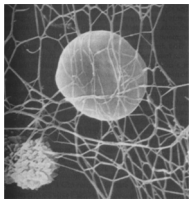
Platelets

Structure & Function

By: Dr. Shahid Habib



Antithrombogenic

(Favors fluid blood)

Thrombogenic

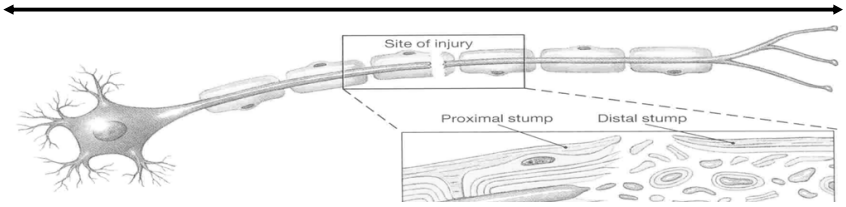
(Favors clotting)

OBJECTIVES

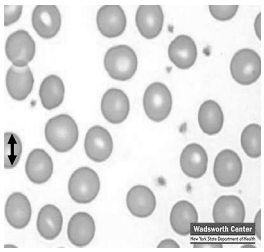
- **At the end of the lecture you should be able to describe…..**
  - ***Structure of Platelets***
  - ***Role of platelet organelles***
  - ***The role of platelets in hemostasis***
  - ***Bleeding disorders***

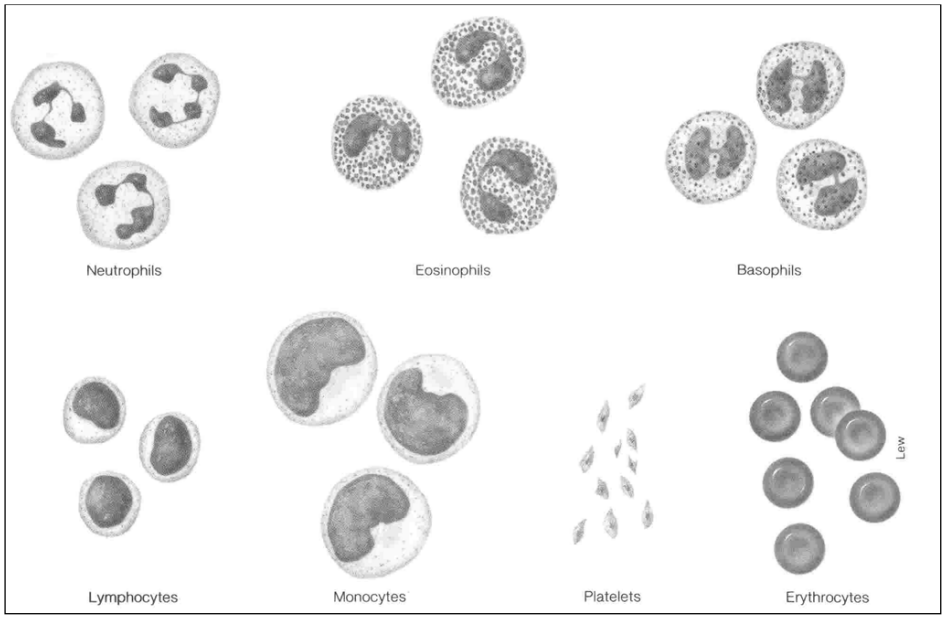
LARGEST AND SMALLEST CELL

SIZE : 1.5 meter



SIZE : 1.5-3um





HEMOSTASIS

- **Prevention of blood loss**

  Or

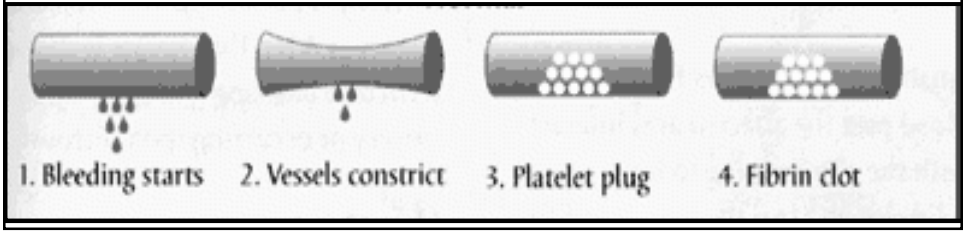
- **Stoppage of bleeding**

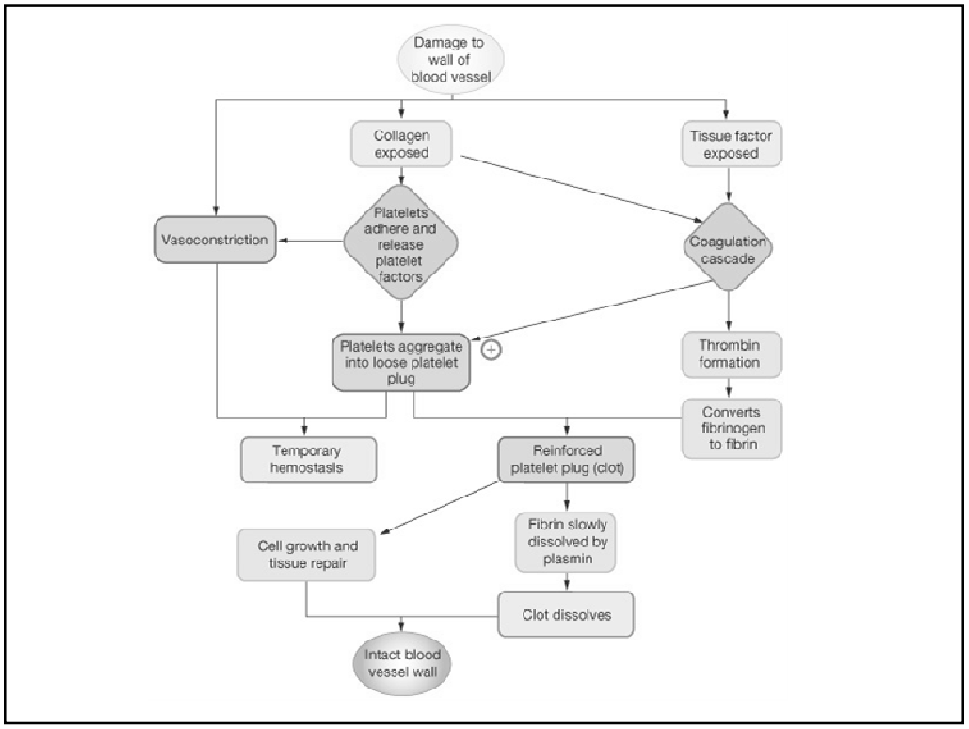
  Or

- **Arrest of bleeding from a broken blood vessel**

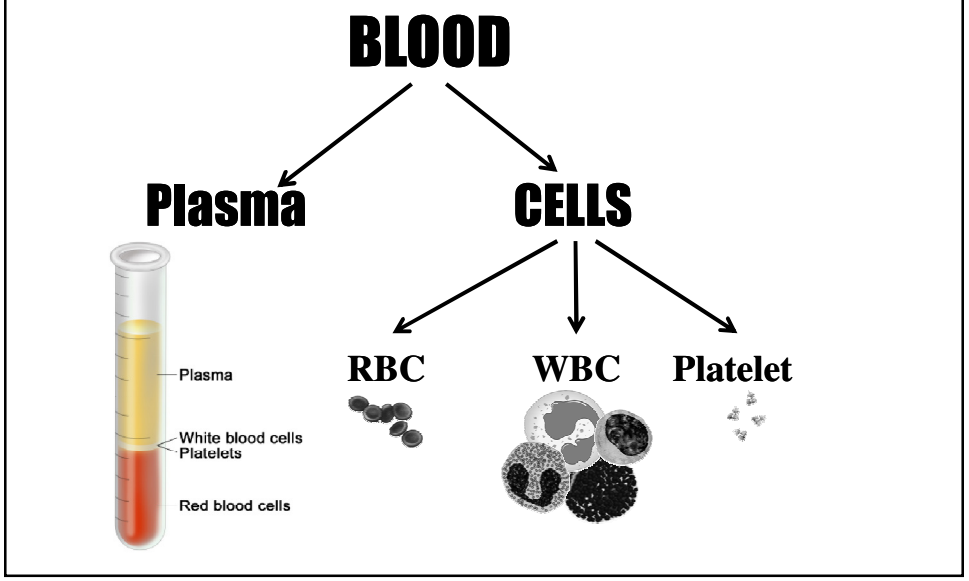
STEPS OF HEMOSTASIS

- **Vascular Spasm**
- **Formation of platelet plug**
- **Blood Coagulation**
- **Clot Retraction**
- **Fibrinolysis**



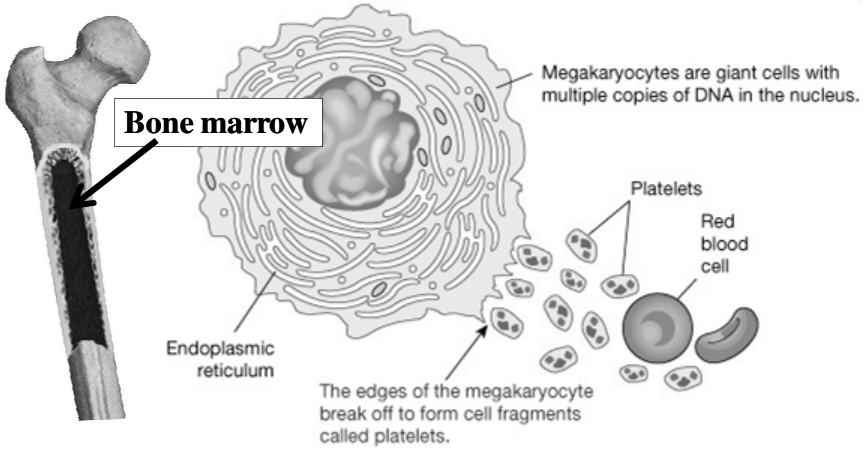


What are platelets?



PLATELETS

Formed by fragmentation from megakaryoctyes

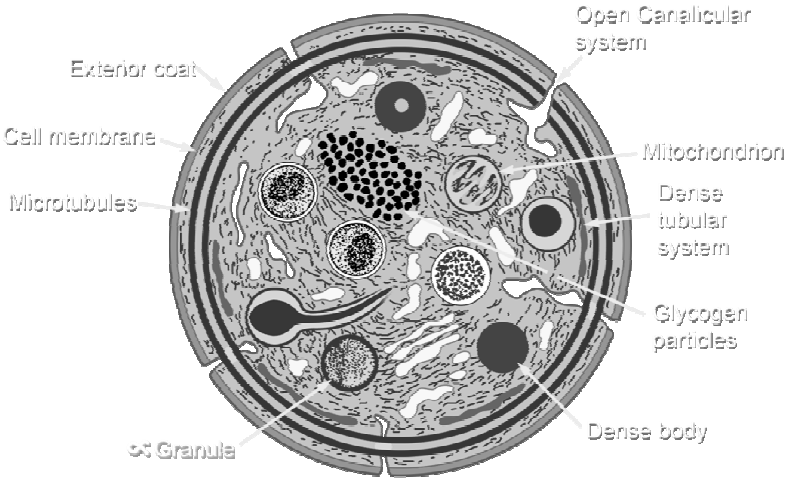


Thrombopoiesis

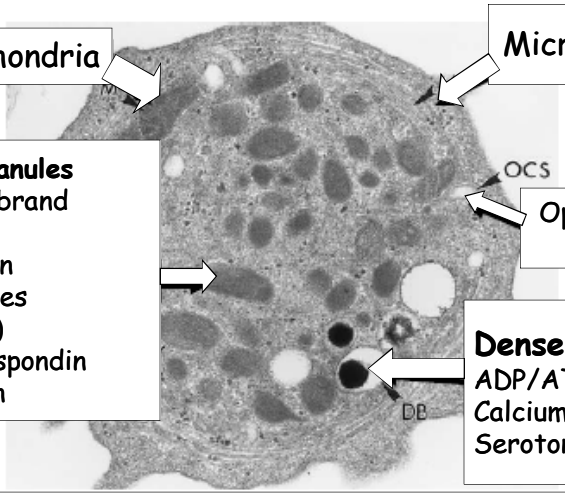
Regulation of thrombopoiesis by Thrombombopoietin

- **Steps:** Stem cell
  - ⇩
  - Megakaryoblast
  - ⇩
  - Megakaryocyte
  - ⇩
  - Platelets

PLATELET ULTRA-STRUCTURE



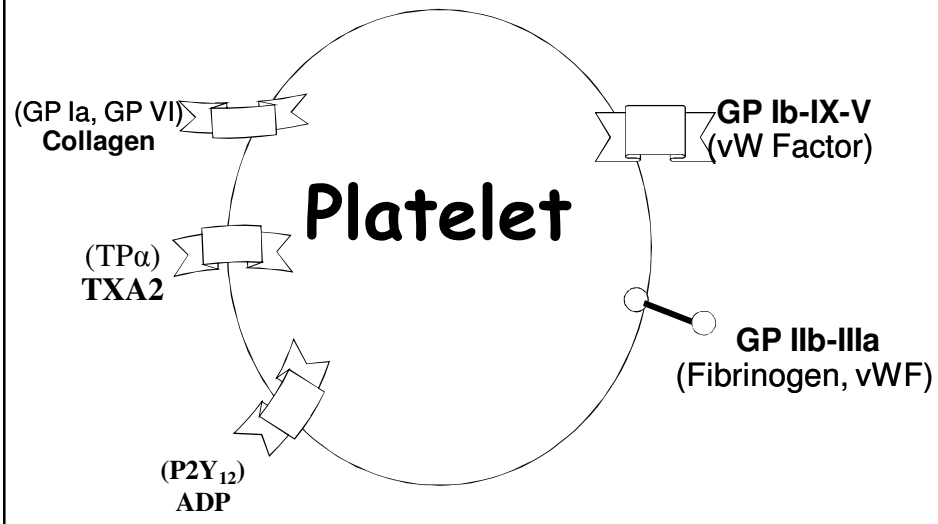
Platelet Ultrastructure



Alpha Granules
von Willebrand Factor
Fibrinogen
Chemokines (PF4,etc.)
Thrombospondin
P-selectin

Dense Granules
ADP/ATP
Calcium
Serotonin

Platelet Receptors



PLATELETS CHARACTERISTICS

SHAPE: MINUTE ROUND OR OVAL DISCS

SIZE: 1.5–3.0 μM IN DIAMETER

LIFE SPAN: 7-10 DAYS

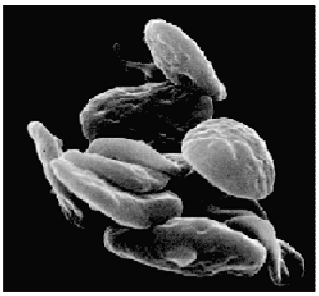
COUNT: 150,000 – 300,000/ MICROLITRER

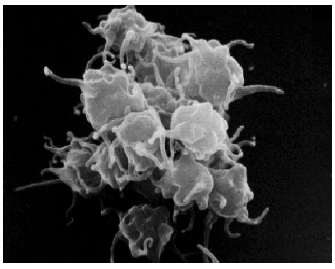
ANUCLEAR AND DISCOID CELL → SPHERICAL WHEN ACTIVATED

SEQUESTERED IN THE SPLEEN; HYPERSPLENISM MAY LEAD TO LOW PLATELET COUNTS

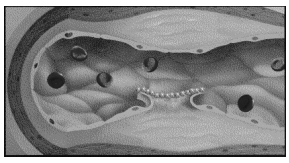
FUNCTIONAL CHARACTERISTICS:

- Contractile (Actin & Myosin) & Adhesive
- Store coagulation factors & enzymes
- Surface Binding sites for fibrinogen, TxA2, VWF, ADP & Collagen

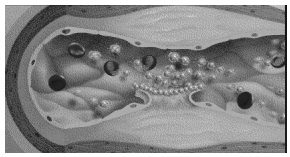




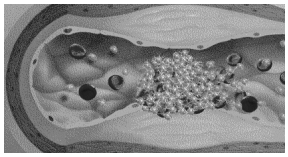
Platelet functions



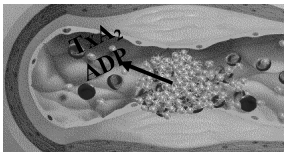
1 Adhesion



2 Activation

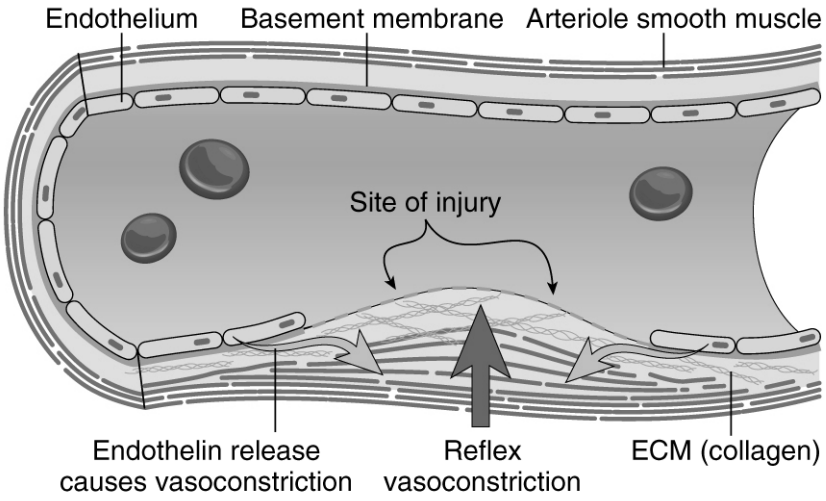


3 Aggregation

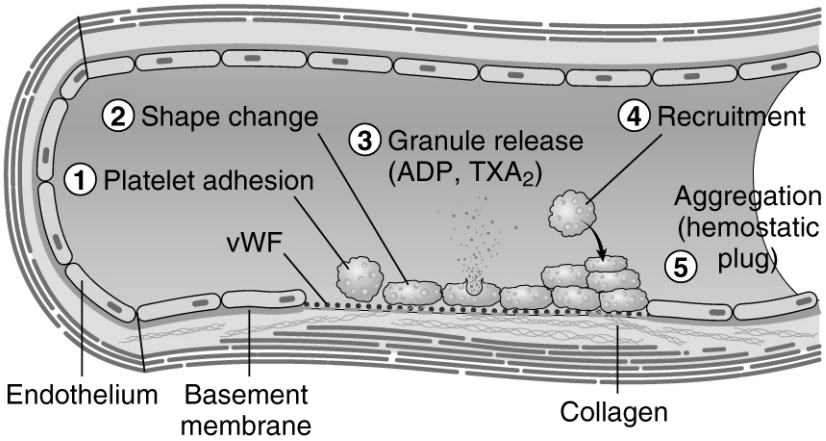


4 Secretion

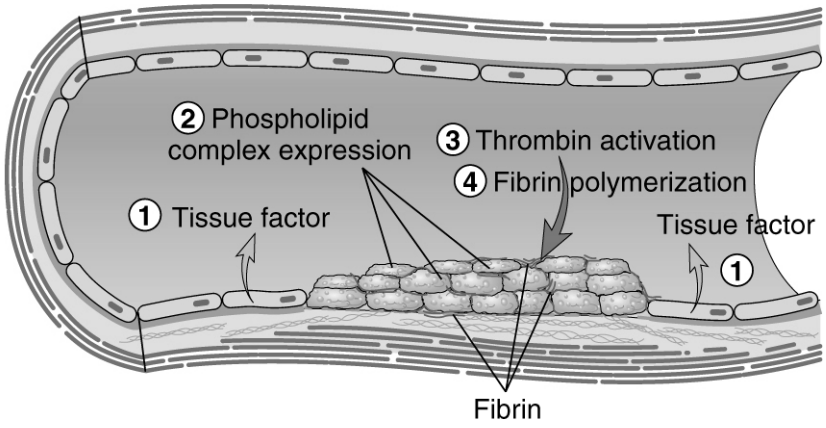
A. VASOCONSTRICTION



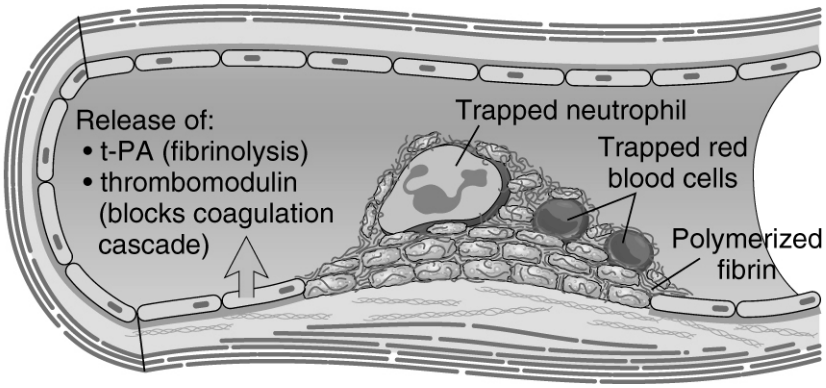
B. PRIMARY HEMOSTASIS

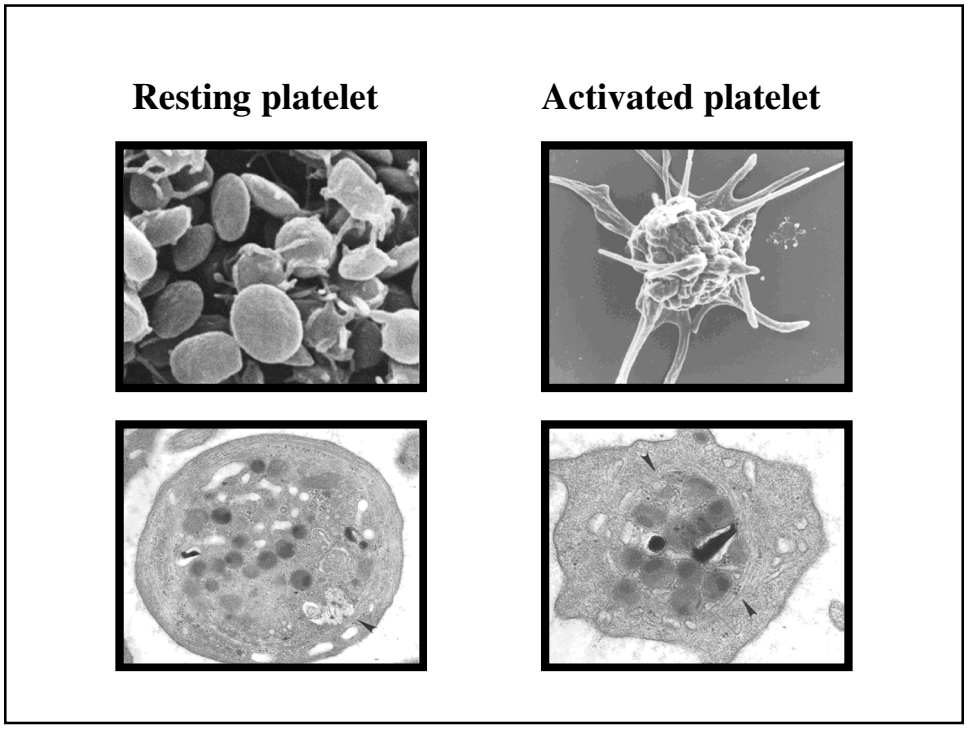


C. SECONDARY HEMOSTASIS



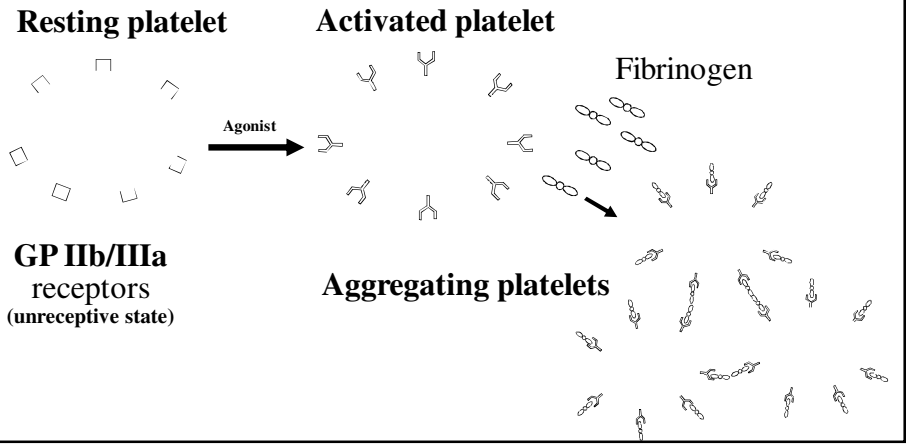
D. THROMBUS AND ANTITHROMBOTIC EVENTS





Platelet Aggregation

Fibrinogen is needed to join platelets to each other via platelet fibrinogen receptors

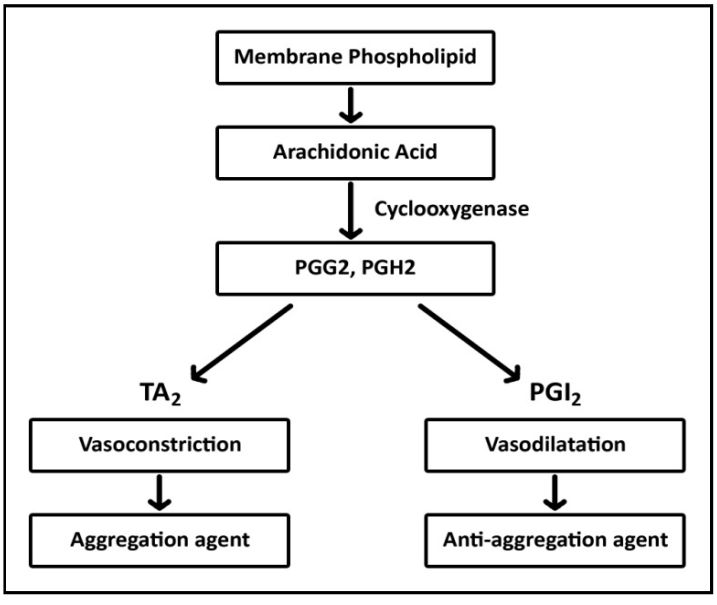


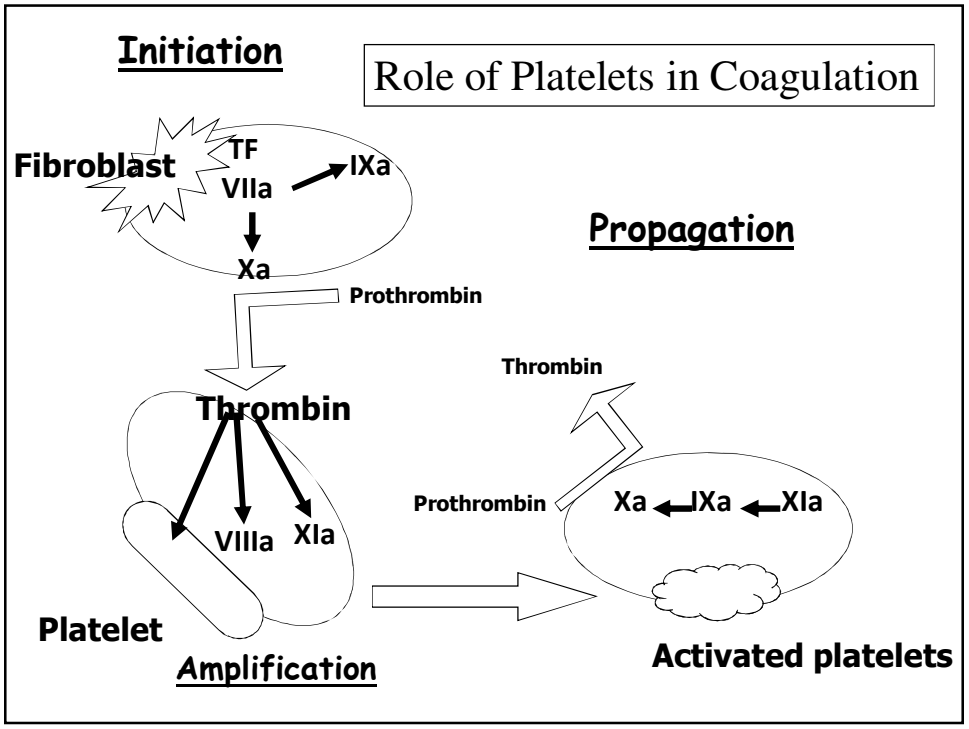
Activated Platelets Secretion

1. 5HT → vasoconstriction
2. Platelet phospholipid (PF3) → clot formation
3. Thromboxane A2 (TXA2) is a prostaglandin formed from arachidonic acid

   Functions of TXA2 :
   - Vasoconstriction
   - Platelet aggregation

   (TXA2 inhibited by aspirin)





Platelet Activation

❖Clot Retraction:

Myosin and actin filaments in platelets are stimulated to contract during aggregation further reinforcing the plug and help release of granule contents

Platelet Functions Summary

- Platelets activated by adhesion when collagen is exposed & form a plug
- Extend projections & swell to Release: thromboxane A2, serotonin & ADP >>> activating other platelets & Coagulation factors
  - Serotonin & thromboxane A2 are vasoconstrictors decreasing blood flow through the injured vessel.
  - ADP causes stickiness and enhances aggregation
- Platelets adhesion receptors (integrins) adhere them to each other forming a hemostatic plug with fibrin to form a Clot
- Myosin and actin filaments in platelets are stimulated to contract to further reinforce the plug and help release of granule contents

Laboratory Testing of Platelet Functions

- Platelet count (& shape)
- Bleeding time
- Platelet Aggregation
- Platelet Function Analyzer (PFA-100)
- Flow-cytometry
- Electron-microscopy
- Granule release products

Platelet Disorders

Adhesion: Bernard-Soulier
Aggregation: Glanzmann thrombosthenia
Granules: Grey Platelet Syndrome
Cytoskeleton: Wiskott-Aldrich syndrome
Secretion: Receptor defects (TXA2, collagen ADP, epinephrine)
Production: thrombocytopenia