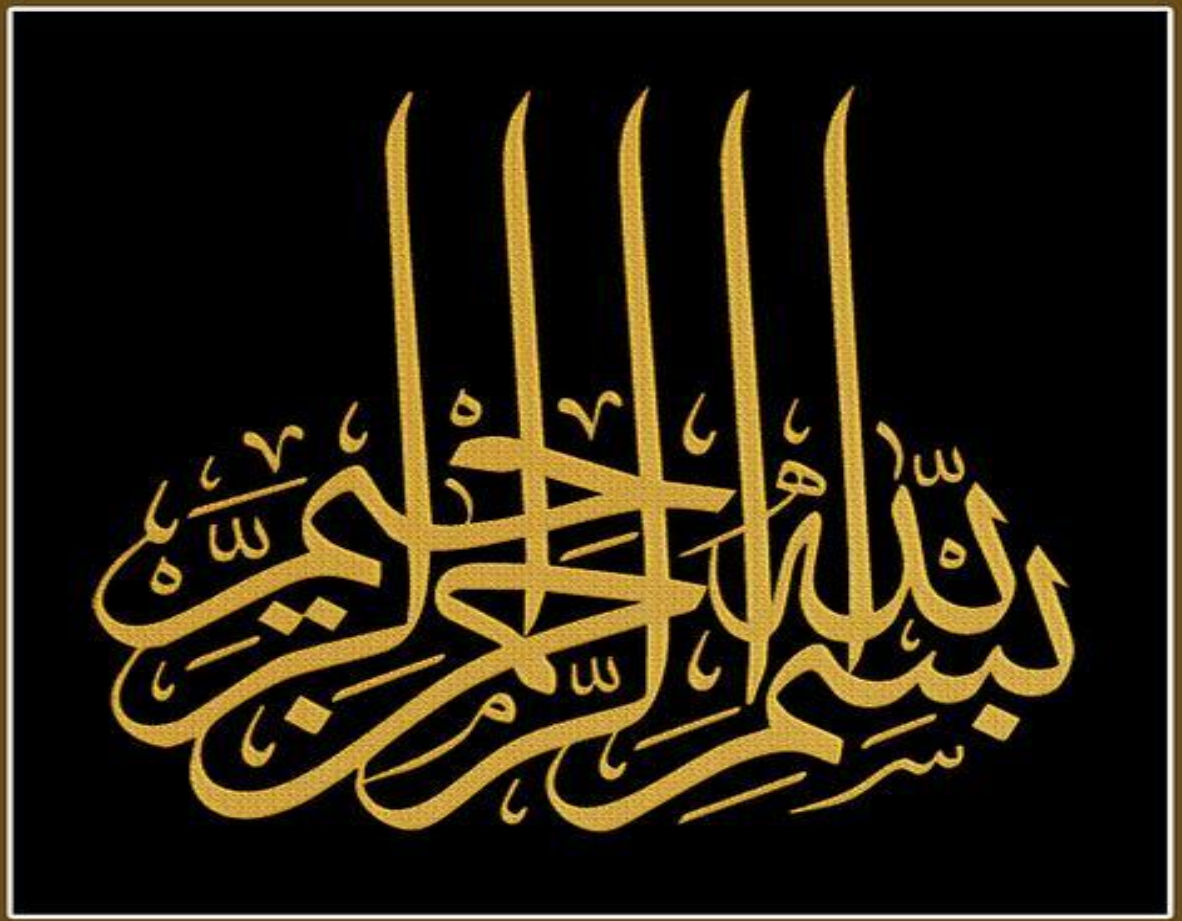

بسم الله الرحمن الرحيم

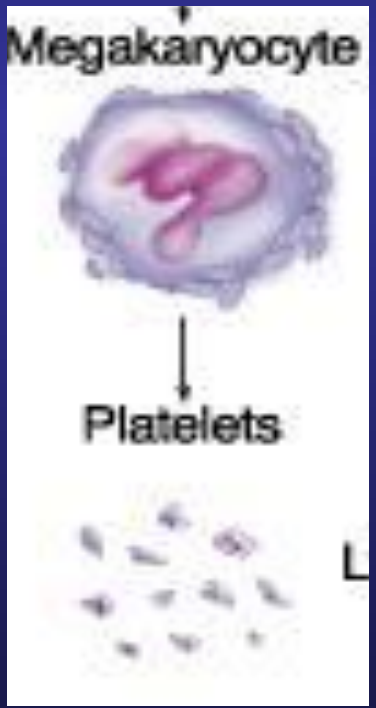
PLATELETS (PLTs)
or
Thrombocytes

Dr. Taj

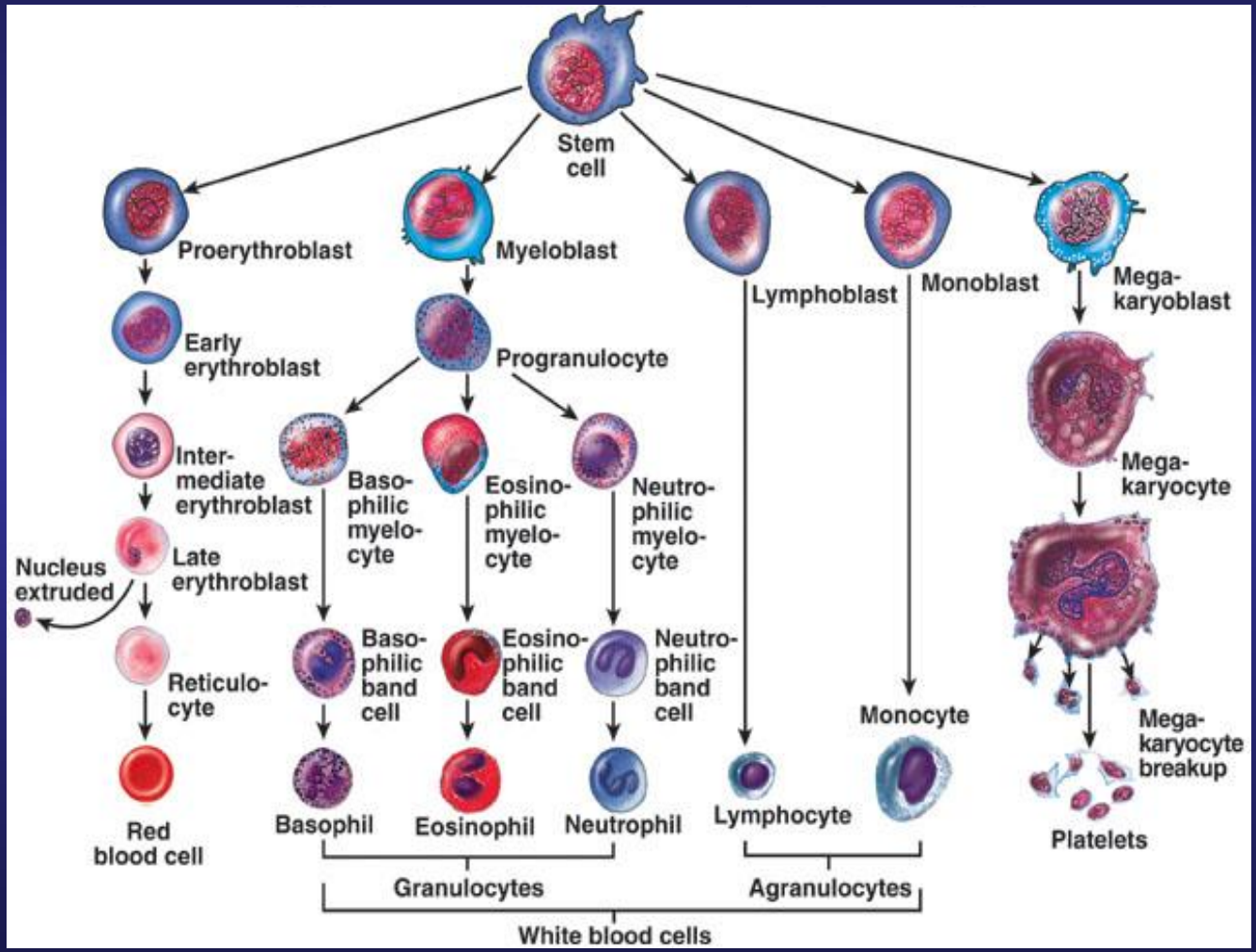
Platelets

Thrombocytes are

- Fragments of megakaryocytes in bone marrow



Hematopoiesis

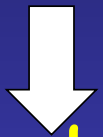


Platelets – cont.

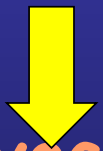
Site of formation: Bone marrow

Steps:

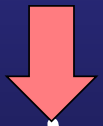
Stem cell



Megakaryoblast



Megakaryocyte



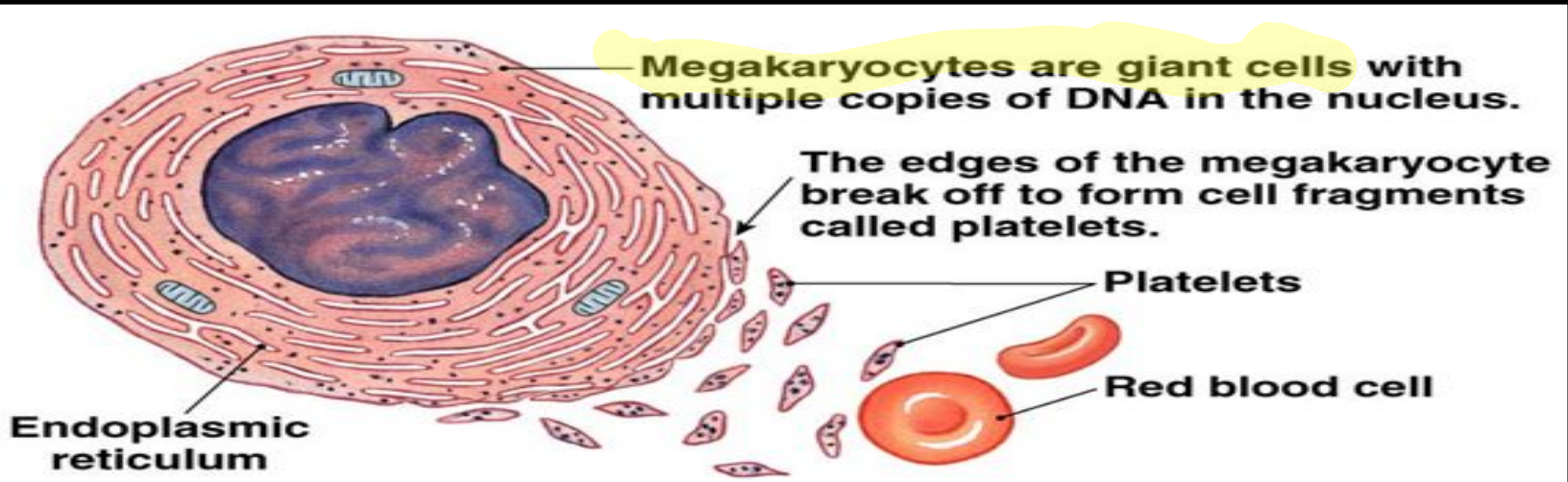
Platelets

Platelets Formation (Thrombopoiesis)

Regulation of thrombopoiesis by Thrombombopoietin

Platelets

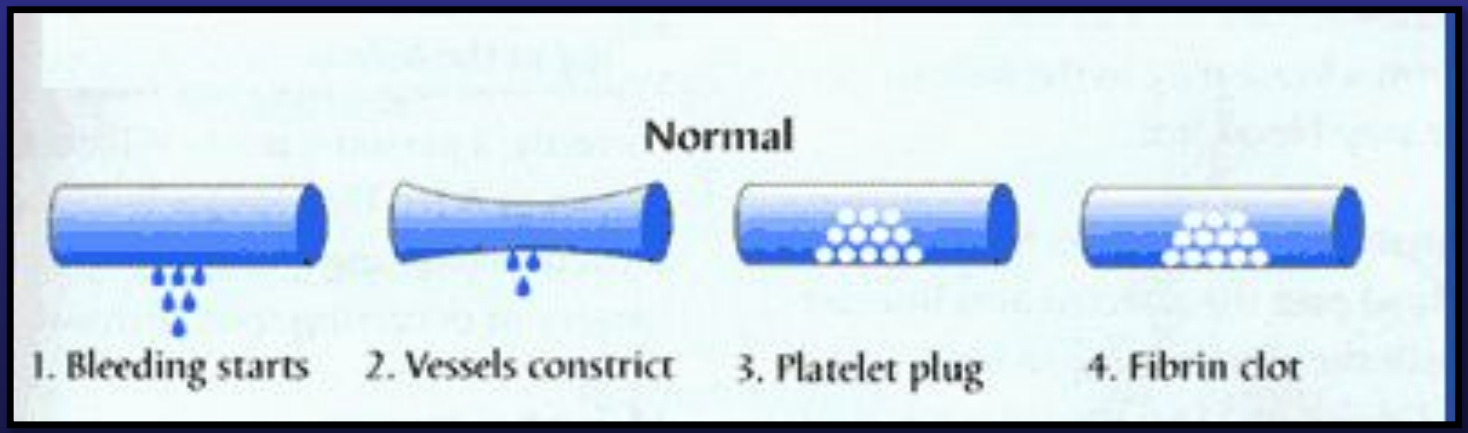
- Platelets are non-nucleated, small, round or oval discs.
- They are formed in the bone marrow by fragmentation of the cytoplasm of giant cells called "***Megakaryocytes***".
- Platelet count normally = 150,000-400,000/µl.



Function of Platelets

- Plays a role in ***Hemostasis*** = prevention of blood loss.

- Whenever a vessel is severed or ruptured, Hemostasis is achieved by several mechanisms;
  1. Vascular spasm.
  2. Formation of a platelet plug.
  3. Formation of a blood clot as a result of blood coagulation.



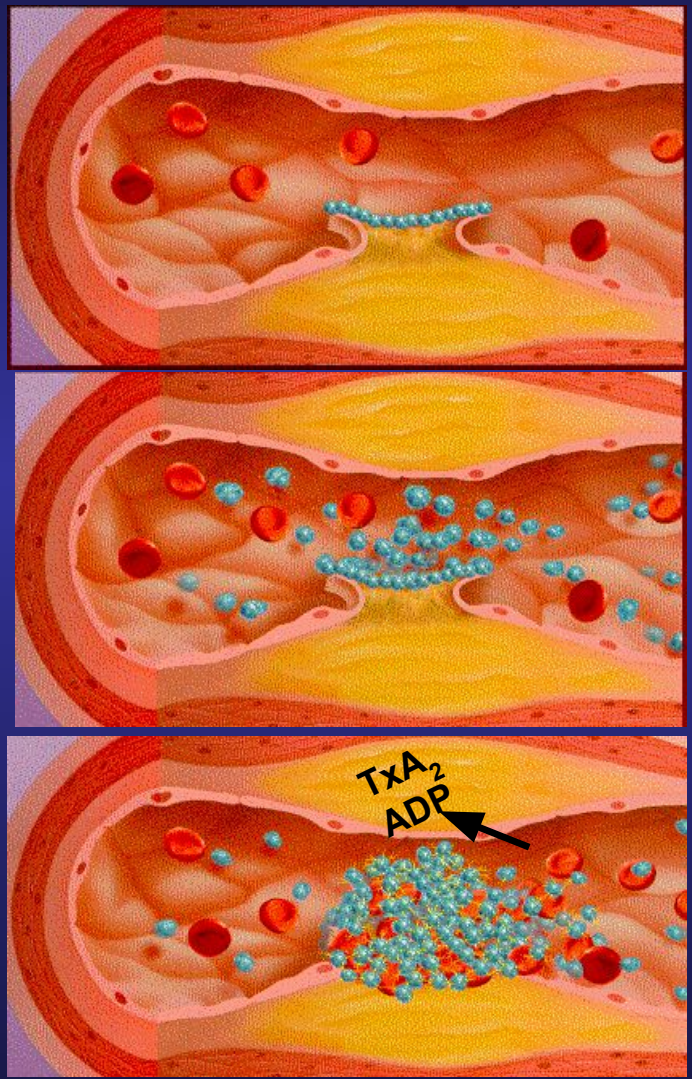
Platelet Functions

Begins with Platelet activation

Platelet Activation

- Adhesion
- Shape change
- Aggregation
- Release
- Clot Retraction

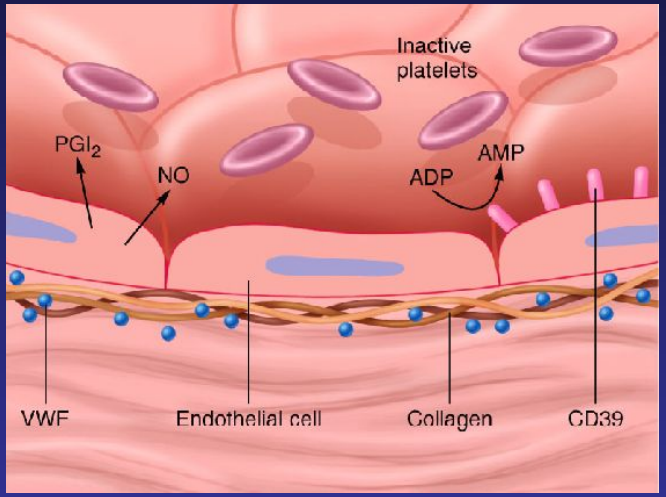
Platelet function

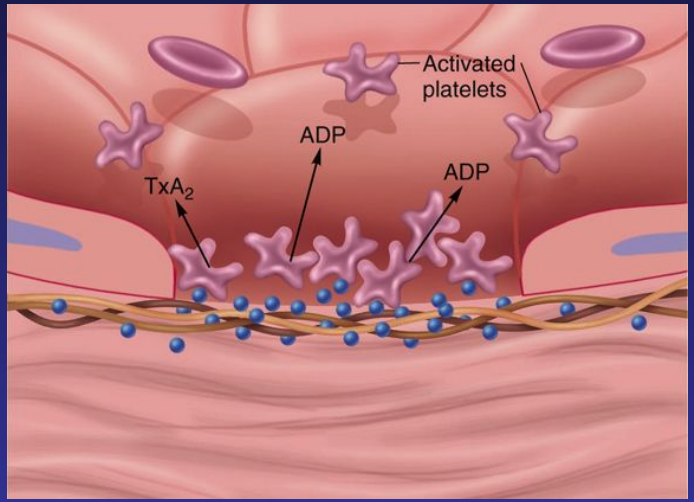


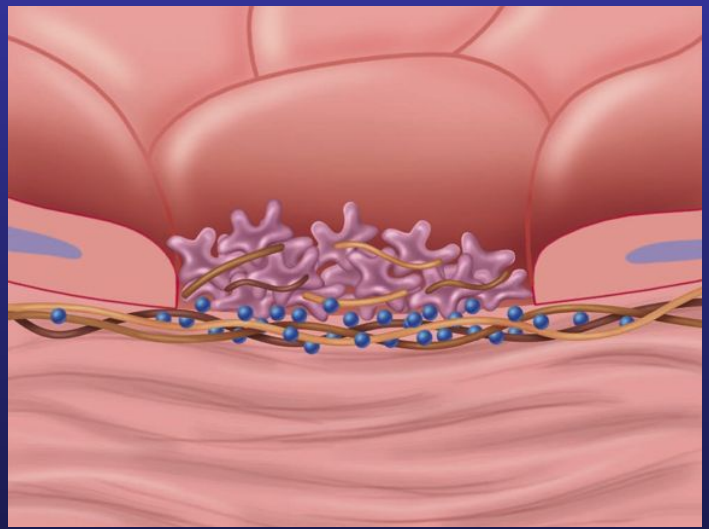
Adhesion

Aggregation

Secretion

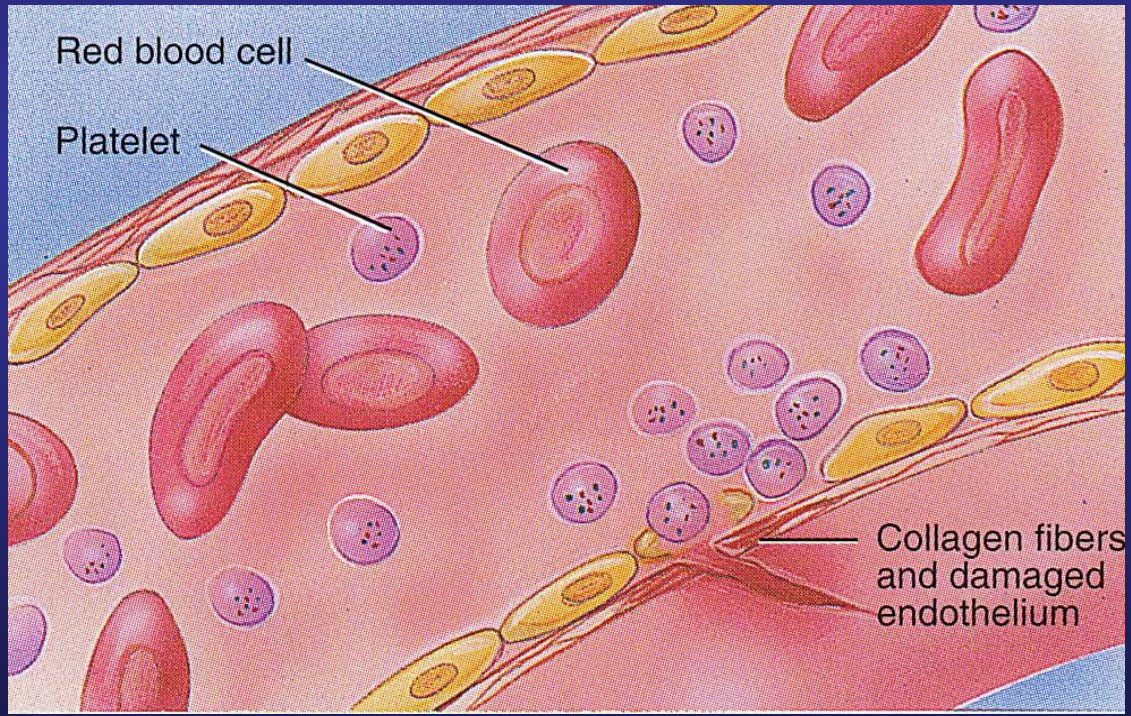

Inactive platelets
PGI_2
NO
ADP
AMP
VWF
Endothelial cell
Collagen
CD39


Activated platelets
ADP
ADP
TxA_2



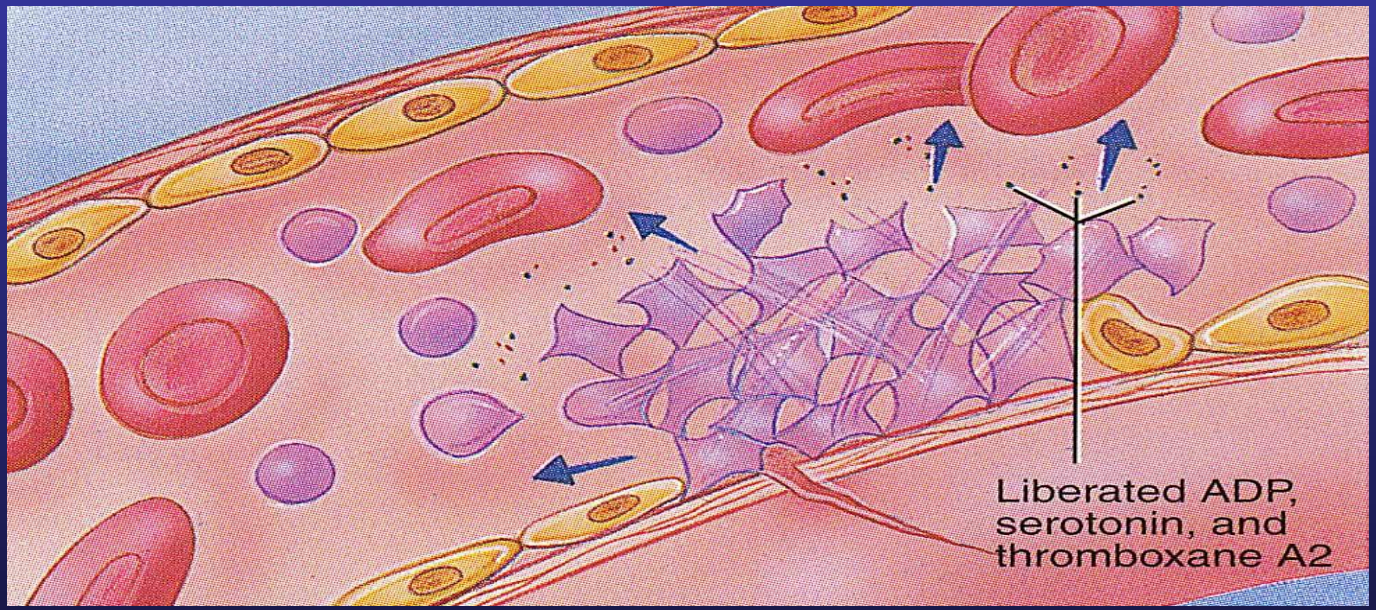
Platelet Adhesion

Platelets stick to exposed collagen underlying damaged endothelial cells in vessel wall



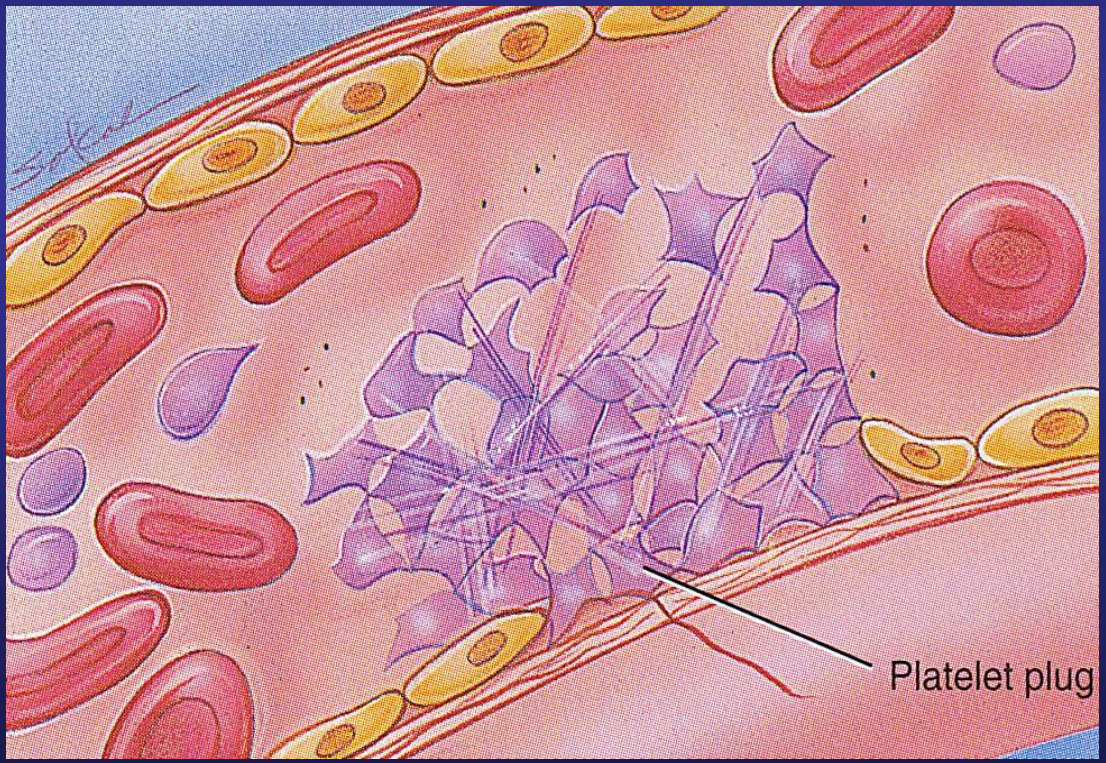
Platelet Release Reaction

- Platelets activated by adhesion
- Extend projections to make contact with each other
- Release Thromboxane A2, Serotonin & ADP activating other platelets
- Serotonin & Thromboxane A2 are vasoconstrictors decreasing blood flow through the injured vessel. ADP causes stickiness

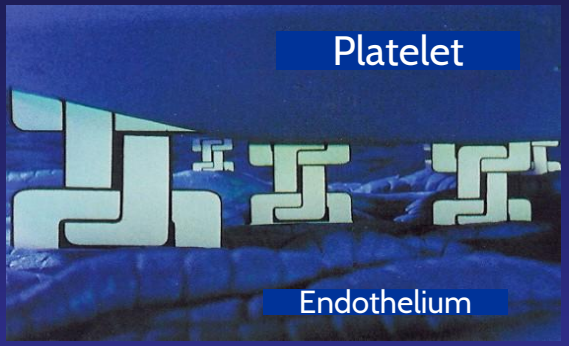


Platelet Aggregation

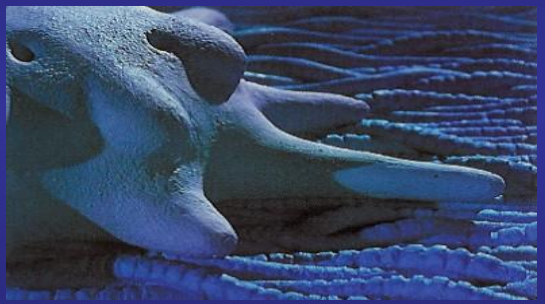
- Activated platelets stick together and activate new platelets to form a mass called a Platelet Plug
- Plug reinforced by fibrin threads formed during clotting process



1. Adhesion

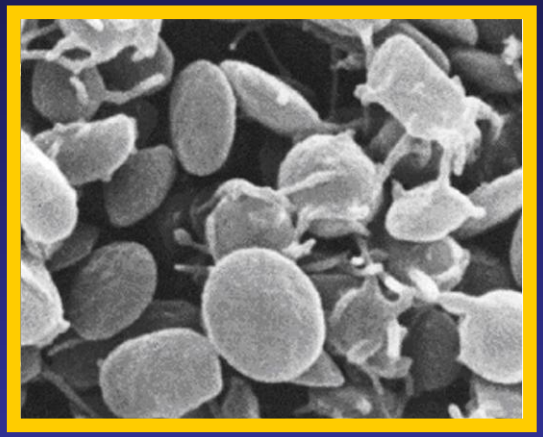


Shape change .2

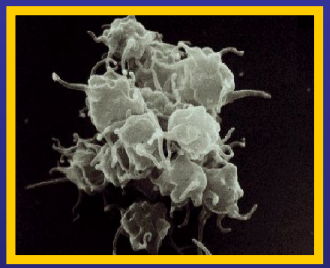


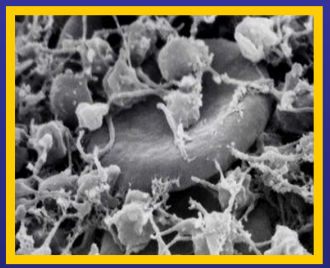
3. Aggregation

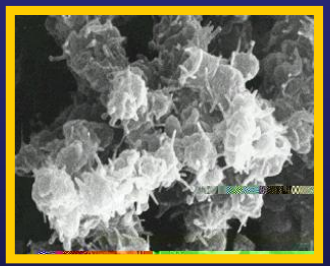
Resting platelet



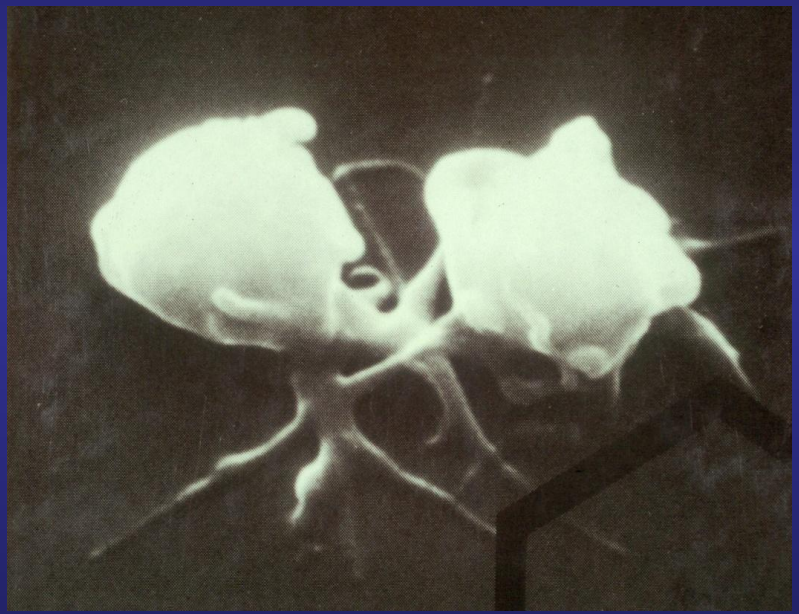
Activated platelet







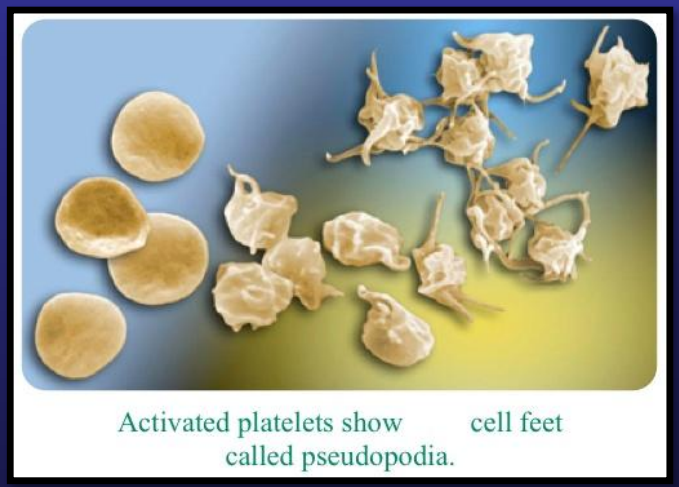
Platelet shape change and Aggregation

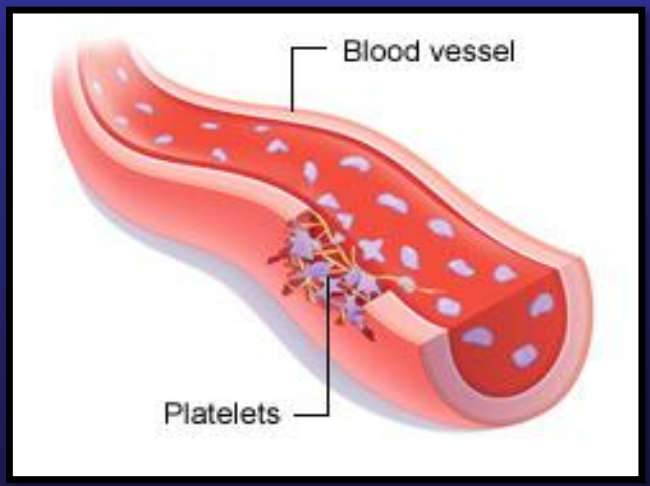


Platelet Aggregation

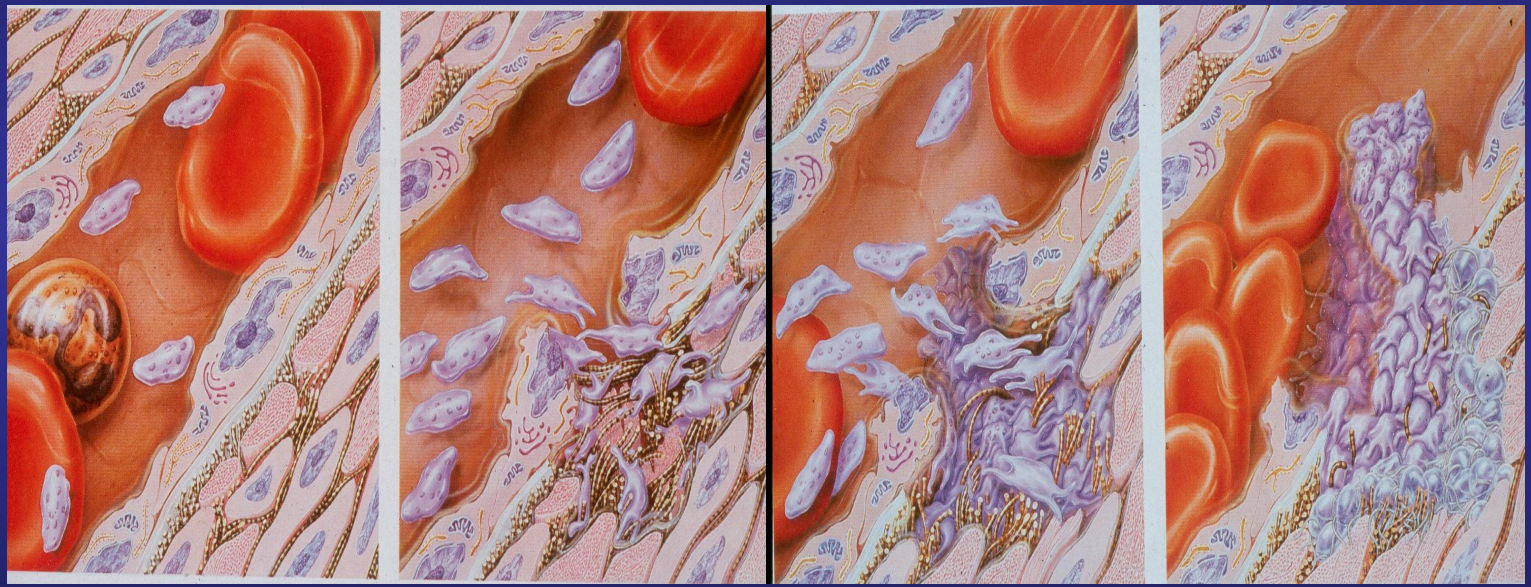
Platelet Plug Formation

1. Blood vessel injury.
2. Platelets come in contact with damaged blood vessel.
3. They become activated and adhere to the injured area.
4. This will activate even more platelets to come to the injured area resulting in platelet plug formation.





Platelet haemostatic plug formation



Platelet Plug formation Cont...

- The platelet plug is a loose plug that is usually successful in blocking the blood loss if the vascular opening is small.

- Then, during the process of blood coagulation, the stronger fibrin threads are formed that will strengthen the platelet plug.

Platelet Plug

Aggregation of platelets at the site of injury to stop bleeding

- Exposed collagen attracts platelets
- Activated platelets release of platelet ADP & TXA2 → ↑ the stickiness of platelets → ↑ Platelets aggregation → plugging of the cut vessel

==========x==========x==========

- Intact endothelium secret prostacyclin → inhibit aggregation

Activated Platelets

Secrete:

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

Function:

- vasoconstriction
- Platelet aggregation

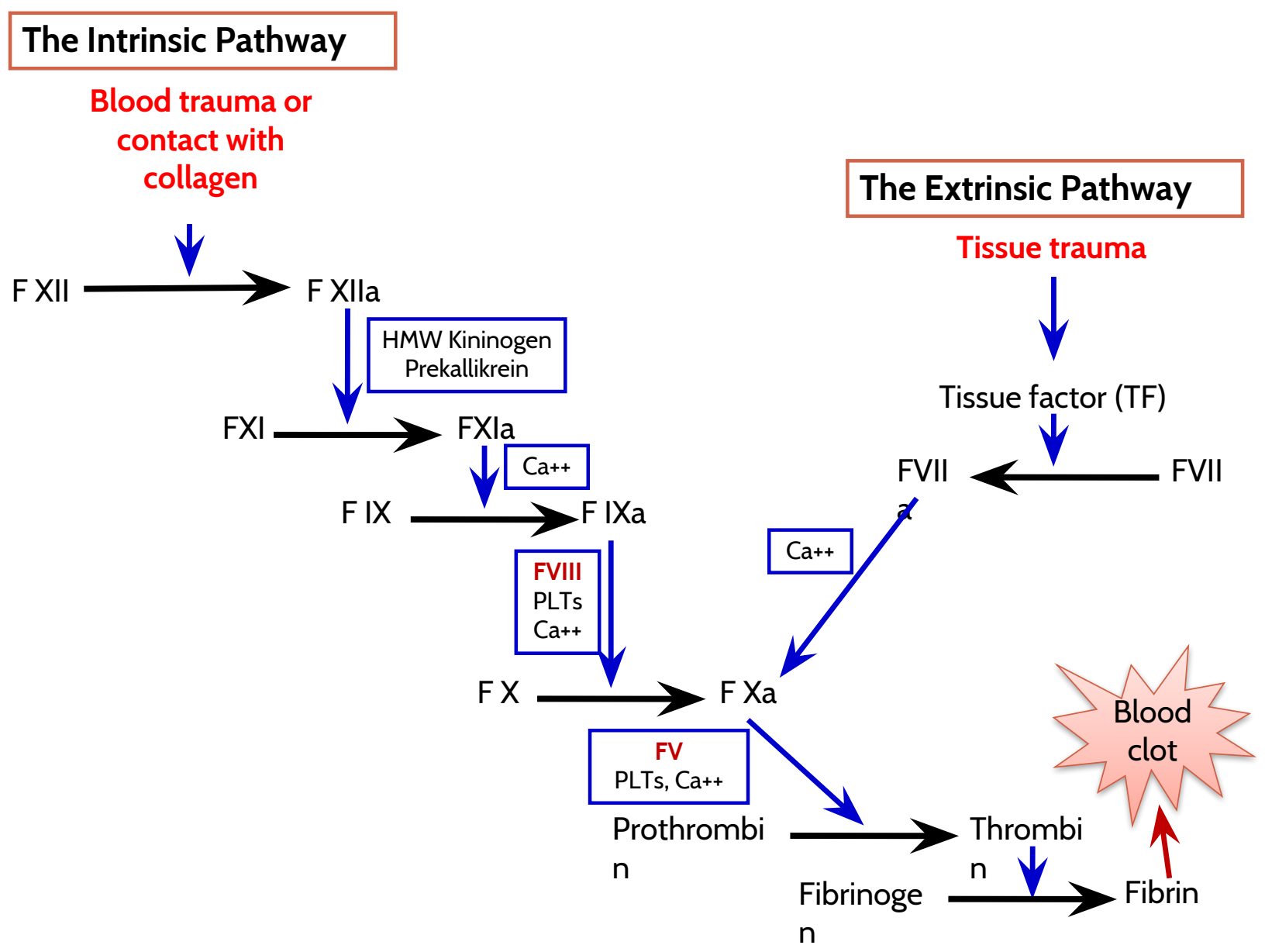
(TXA2 inhibited by ASPIRIN)

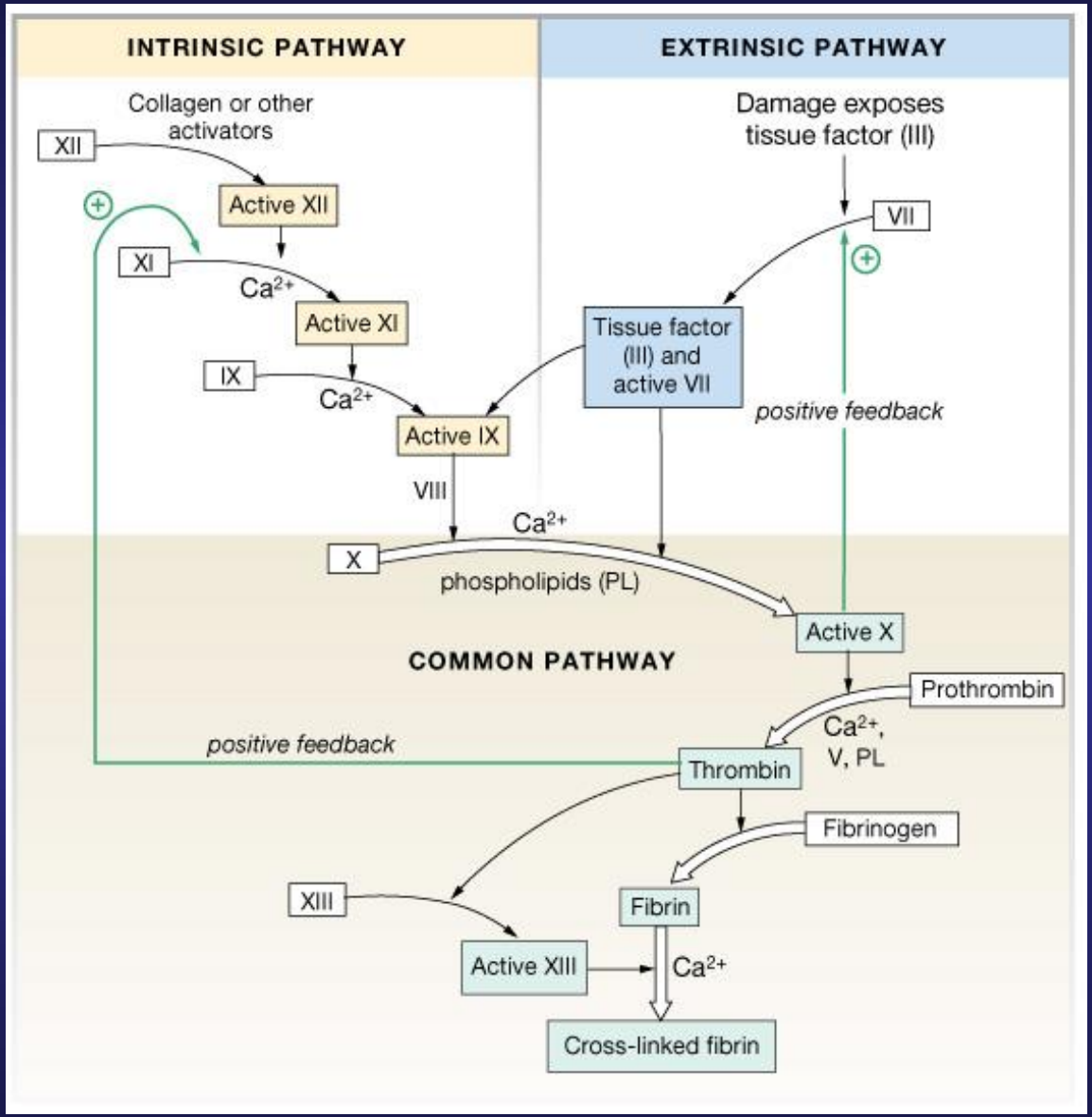
Blood coagulation

- Initiation on blood coagulation occurs by two ways:

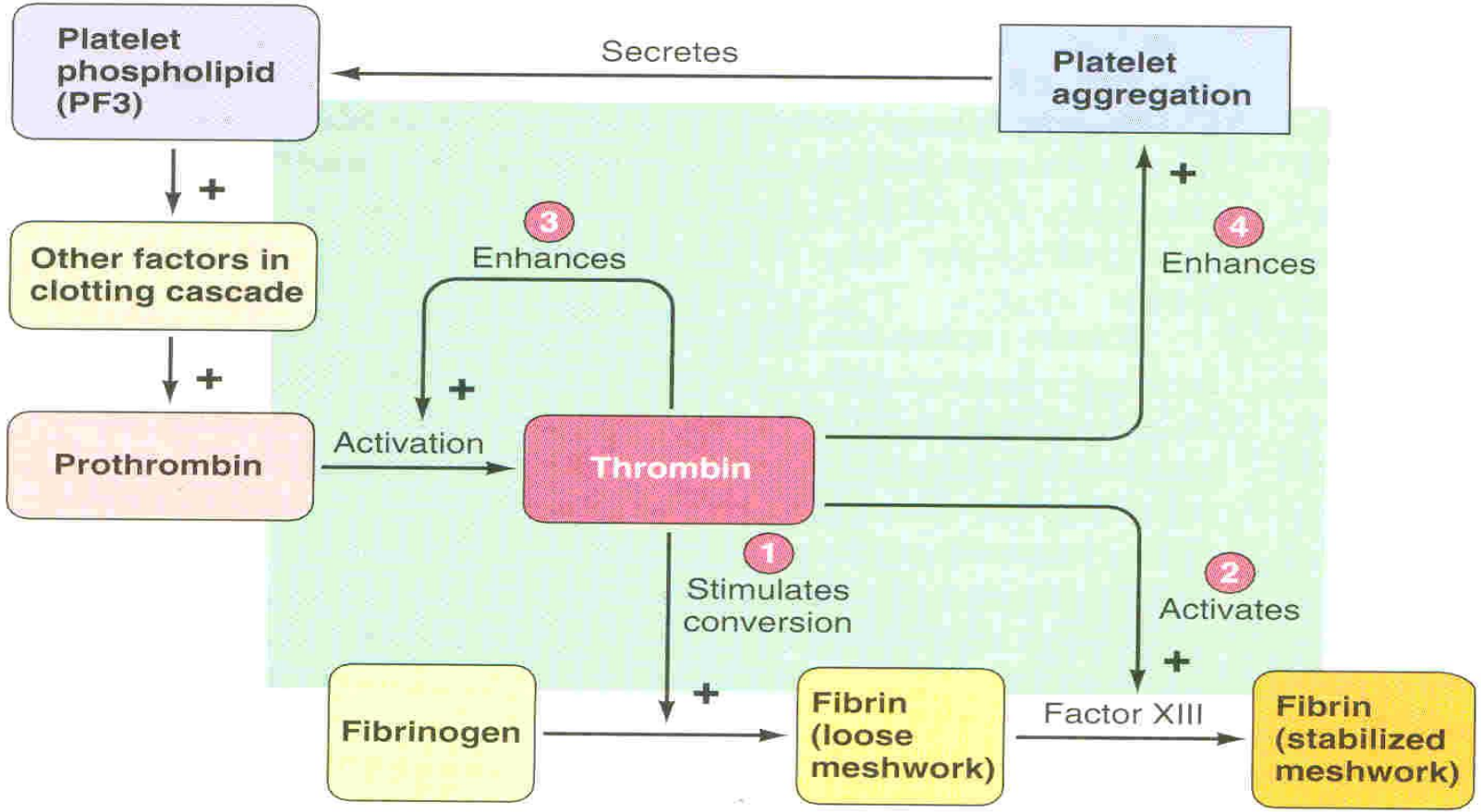
1. ***The extrinsic pathway***: initiated by trauma to blood vessel.

2. ***The intrinsic pathway***: initiated in the blood itself.


The Intrinsic Pathway
Blood trauma or contact with collagen
F XII
F XIIa
HMW Kininogen
Prekallikrein
FXI
FXIa
Ca++
F IX
F IXa
FVIII
PLTs
Ca++
F X
F Xa
FV
PLTs, Ca++
Prothrombin
Thrombin
Fibrinogen
Fibrin
Blood clot
The Extrinsic Pathway
Tissue trauma
Tissue factor (TF)
FVII
FVII a
Ca++


INTRINSIC PATHWAY
EXTRINSIC PATHWAY
Collagen or other activators
XII
Active XII
XI
Ca2+
Active XI
IX
Ca2+
Active IX
VIII
Damage exposes tissue factor (III)
VII
Tissue factor (III) and active VII
positive feedback
Ca2+
X
phospholipids (PL)
Active X
COMMON PATHWAY
Prothrombin
Ca2+, V, PL
positive feedback
Thrombin
Fibrinogen
XIII
Fibrin
Active XIII
Ca2+
Cross-linked fibrin

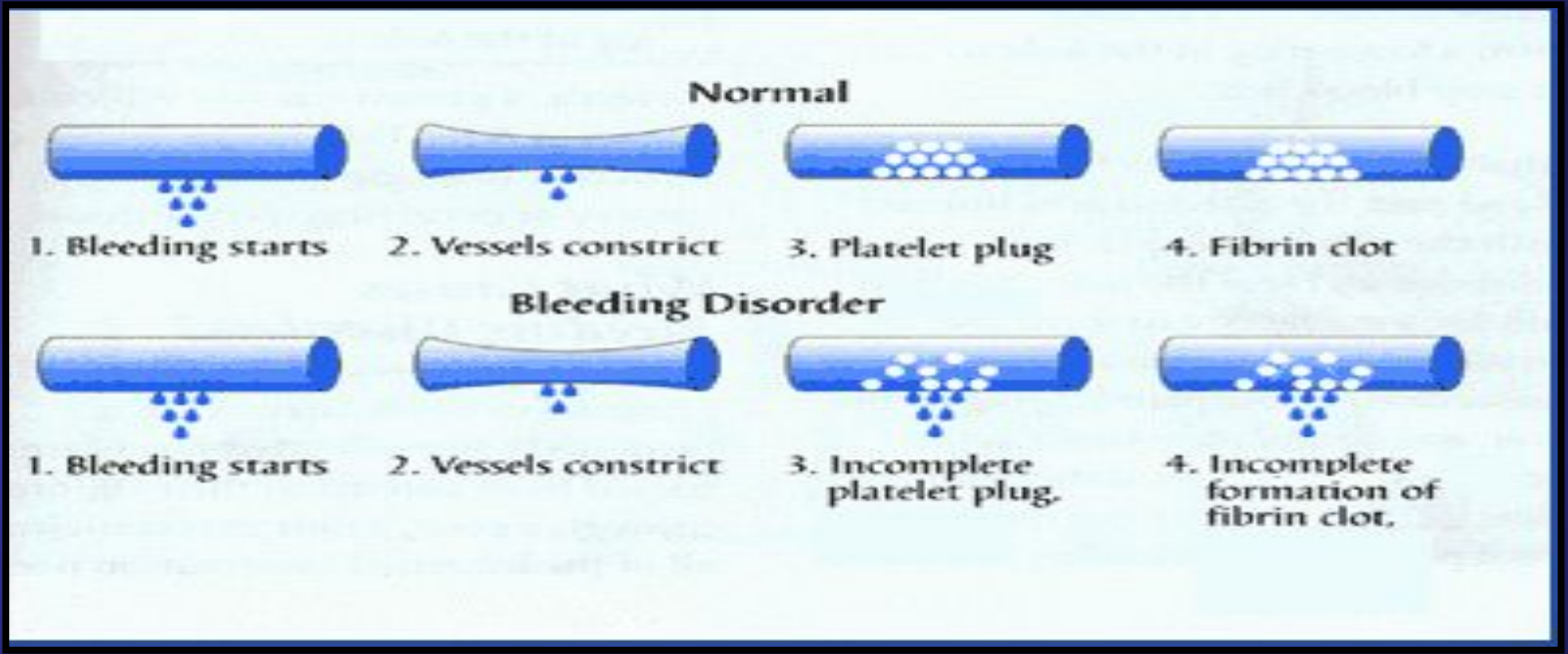
ROLE OF THROMBIN IN HEMOSTASIS



ROLE OF CALCIUM IONS IN CLOTTING

- No $Ca^{++} \rightarrow$ No Clotting
- Blood samples are prevented from clotting by adding:
  - Citrate ions $\rightarrow$ Deionization of Ca^{++}
  - Oxalate ions $\rightarrow$ ppt the Ca^{++}

Bleeding Disorders



- Excessive bleeding can result from;
  - Platelet defects: deficiency in number (thrombocytopenia) or defect in function.
  - Deficiency in coagulation factors (e.g. hemophilia).
  - Vitamin K deficiency.

BLEEDING & CLOTTING DISORDERS

A. Liver diseases & Vitamin-K deficiency
B. Hemophilia
C. Thrombocytopenia

BLEEDING DISORDERS

Liver diseases & Vitamin-K deficiency

- e.g. Hepatitis, Cirrhosis
  - Decreased formation of clotting factors
  - Increased clotting time

- Vitamin K dependent factors
  - Prothrombin, Factor VII, IX, X

HEMOPHILIA

- **HEMOPHILIA - A**
  - Classic Hemophilia
  - 85 % cases
  - Def. Of factor VIII
- **HEMOPHILIA - B**
  - 15 % cases
  - Def. Of factor IX

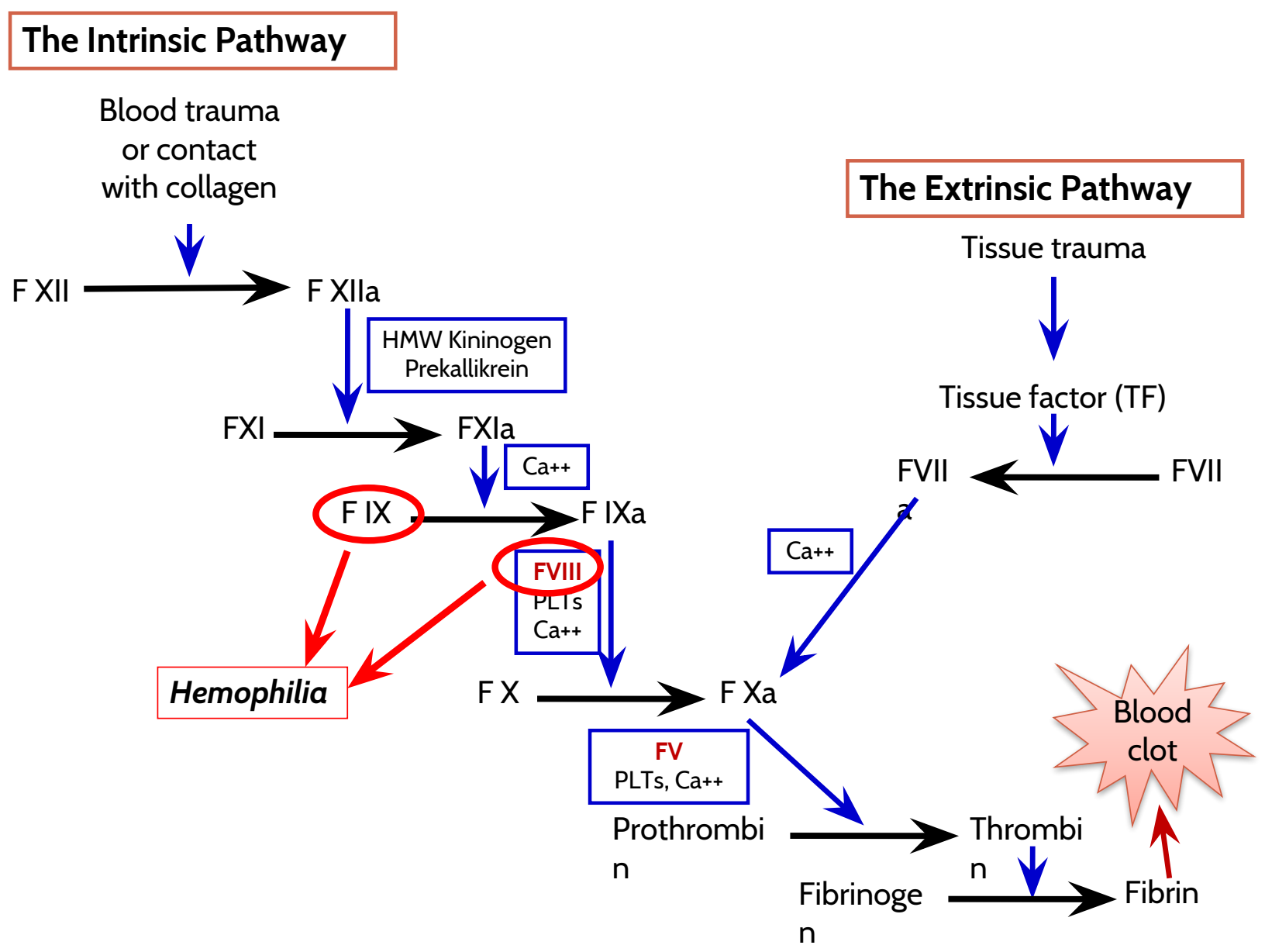
HEMOPHILIA

- Genetic disorders
- Transmitted by female chromosome as recessive trait, it is X linked.
- Occurs exclusively in male. Females are carriers.

- Types
  - Hemophilia A
  - Hemophilia B

HEMOPHILIA

- **Clinical Features**
  - **Easy bruising, massive bleeding after trauma or operation, hemorrhages in joints**
  - **Deficiency of Factor VIII ---- Hemophilia A**
  - **Deficiency of Factors IX ---- Hemophilia B**
  - **Rx**
    - **Injection of factor VIII (Hemophilia A)**
    - **Injection of factor IX (Hemophilia B)**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FXI
FXIa
Ca++
F IX
F IXa
FVIII
PLTs
Ca++
Hemophilia
F X
F Xa
FV
PLTs, Ca++
Prothrombin
Thrombin
Fibrinogen
Fibrin
Blood clot
The Extrinsic Pathway
Tissue trauma
Tissue factor (TF)
FVII
FVII a
Ca++

THROMBOCYTOPENIA

- PLT count upto 50,000 ul
- Less than 10,000 ------ Fatal
- ETIOLOGY
- Decreased production
  - Aplastic anemia
  - Leukemia
  - Drugs
  - Infections (HIV, Measles)

THROMBOCYTOPENIA

- Increased destruction
  - ITP
  - Drugs
  - Infections
- Clinical Features
  - Easy brusability
  - Epistaxis
  - Gum bleeding
  - Hemorrhage after minor trauma
  - Petechiae/Ecchumosis

THROMBOCYTOPENIA

- Diagnosis
  - PLT decreased
  - B.T increased
- Rx
  - Rx of the underlying cause
  - PLT concentrates
  - Fresh whole blood transfusion
  - Splenectomy

Bleeding Disorders Cont…

- Hemophilia:
  - ↑ bleeding tendency.
  - X-linked disease.
  - Affects males.
  - 85% due to FVIII deficiency (hemophilia A), and 15% due to FIX deficiency (hemophilia B).

- Vitamin K deficiency & liver disease:
  - Almost all coagulation factors are synthesized in the liver.
  - Prothrombin, FVII, FIX, & FX require vitamin K for their synthesis.

Anticoagulants

- Heparin
  - Liver, lungs, mast cells, basophils
  - Direct antithrombin
  - Prevent the conversion of Prothrombin to Thrombin
  - Injection only
  - 6-8 hours

- Warfarin
  - Almost all coagulation factors are synthesized in the liver.
  - Suppresses the synthesis of Prothrombin, FVII, FIX, & FX vitamin K dependent factors
  - Orally
  - 48 hours

Thank you