

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

رَبِّ زِدْنِي عِلْمًا

اللَّهُمَّ أَرِنِي حَقِيقَةَ الْأَشْيَاءِ كَمَا هِيَ

“O Allah! Show me the reality of all things as it (really) is..”

BLOOD Physiology

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LECTURER in Physiology

Hemostasis

```
graph TD; A[Hemostasis] --> B[Vasoconstriction]; A --> C["Platelet Plug  
(Platelet activation & aggregation)  
Primary Hemostasis"]; A --> D["Coagulation Cascade  
(deposition of Fibrin)  
Secondary Hemostasis"];
```

Vasoconstriction

Platelet Plug
(Platelet activation & aggregation)

Primary Hemostasis

Coagulation Cascade
(deposition of Fibrin)

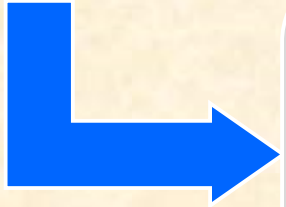
Secondary Hemostasis

Platelets

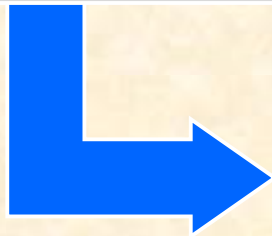
- ▶ Anucleated cells derived from Megakaryocytes
- ▶ Lifespan of around 10 days
- ▶ Cytosol contains actin & myosin; organelles (GA, Mitochondria, ER); enzymes (that synthesize prostaglandins); fibrin-stabilizing factor
- ▶ Cell membrane has numerous glycoprotein that play imp role in platelet plug & clot formation

Hemostasis- Platelet activation

Binding of
Platelets
with vWF

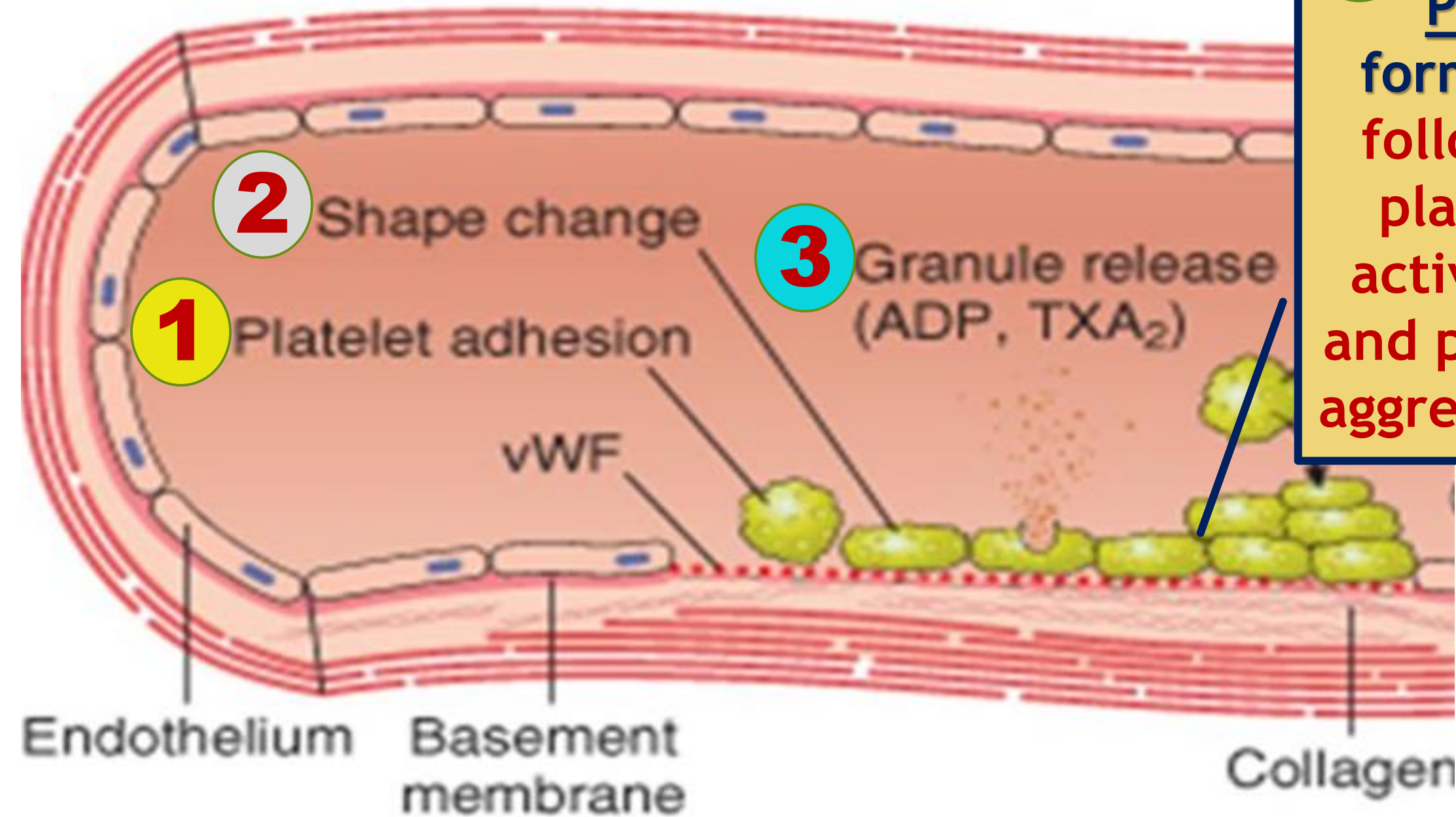


**Increase
intracellular
Calcium**



**Shape Change
Discharge of granule
contents
PLA2 activation - TxA2
formed (platelet activator)**

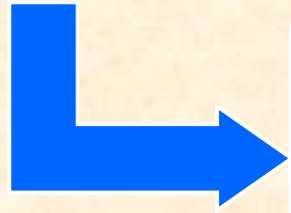
Primary Hemostasis - Platelets



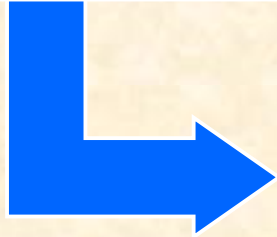
4 Platelet Plug formation following platelet activation and platelet aggregation.

Hemostasis- Thrombocytopenia

↓ Platelets



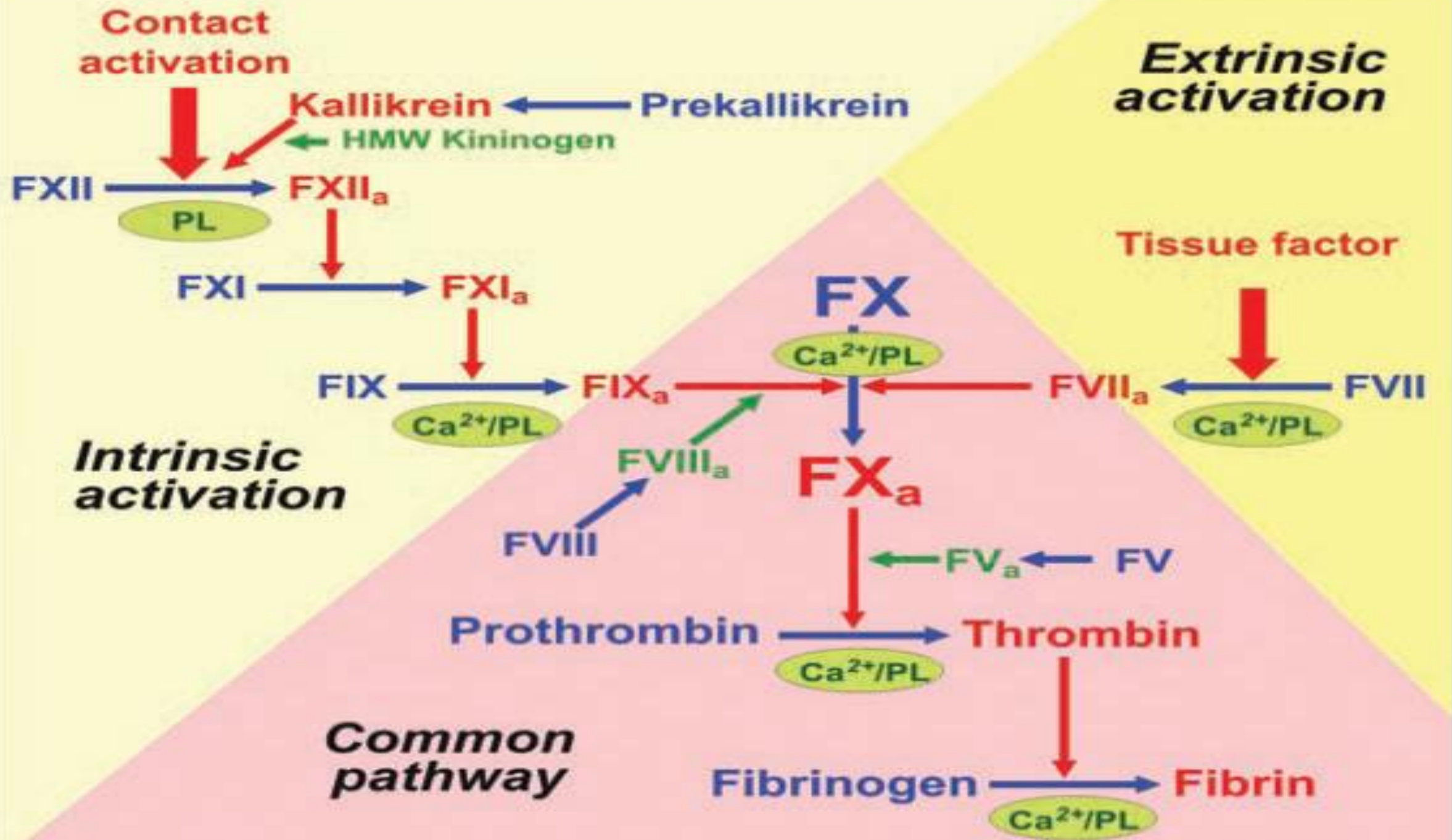
Tendency to bleed (small vessel)



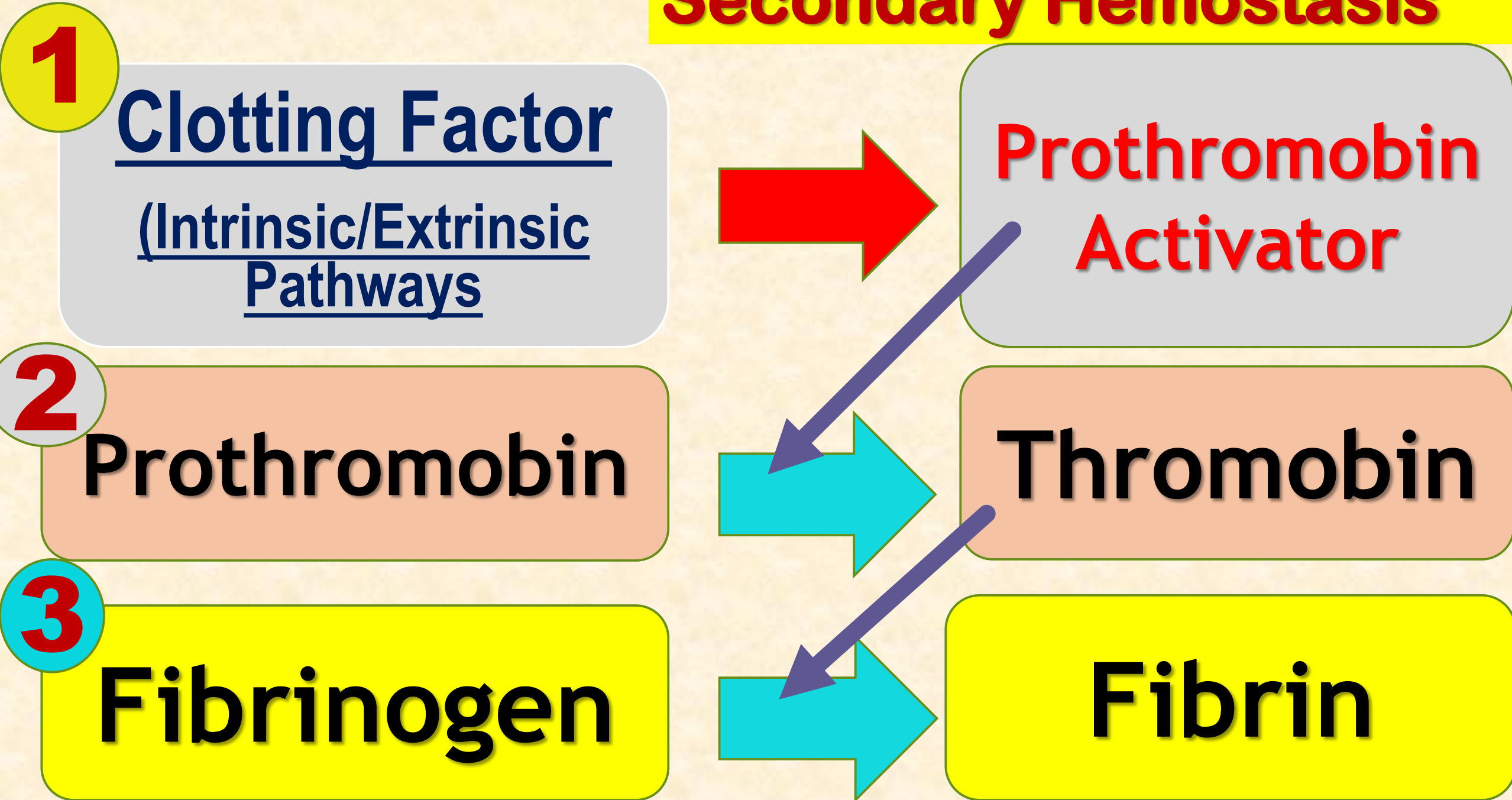
**Petechial Lesion
Purpura
Ecchymoses**



Ecchymoses



Secondary Hemostasis



Platelets

```
graph TD; A[Platelets] --> B[Release Factor XIII]; A --> C[Have receptors for Fibrinogen]; B --> D[Clot retraction]; C --> D;
```

**Release Factor
XIII**

**Have receptors
for Fibrinogen**

**Clot
retraction**

Hemostasis

Coagulation



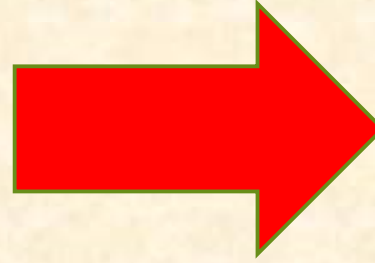
**Anti-
Coagulation**

Anti-Coagulation

- ▶ **Endothelium:** smooth surface, Glycocalyx ;
Thrombomodulin-thrombin complex
- ▶ **Fibrin:** **Most of the thrombin becomes adsorbed to the fibrin - thus, thrombin does NOT spread to other parts of body via blood**
- ▶ **Anti-Thrombin III**
- ▶ **Heparin:** **Mast cells pericapillary tissue in Lungs**
- ▶ **Plasminogen:** **Tissue plasminogen converts plasminogen to plasmin**

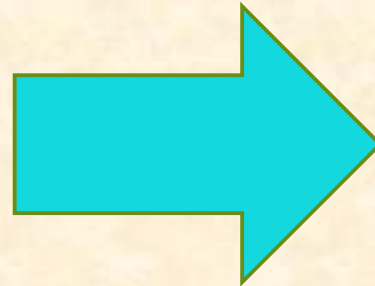
Anti-Coagulation

Thrombomodulin-
thrombin complex



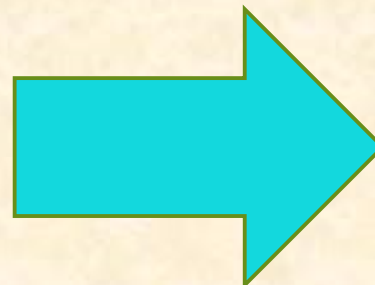
Activate Protein
C - which
inactivates
Factor V & VIII

Heparin
AntiThrombin III
complex



Removes Factors
(activated)
II, IX, X, XI, XII

Plasmin



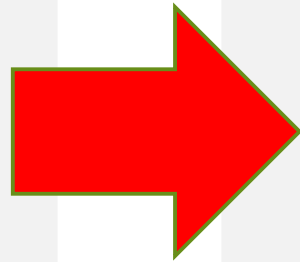
Clot lysis
(few days later)

Hemostasis Tests (Common)

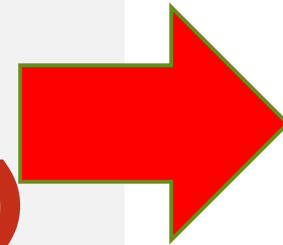
- ▶ Platelet Count
- ▶ PT
- ▶ INR
- ▶ aPTT

ProThrombin Time

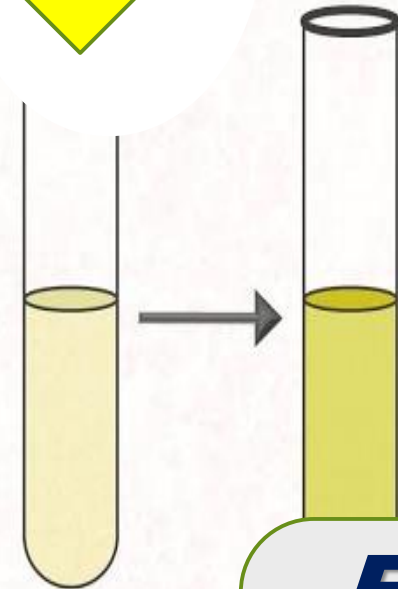
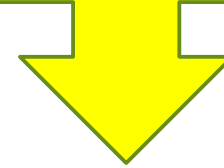
Blood collected in tube and oxalate or citrate added



Centrifuge (cellular part & plasma separate) Cellular Part Removed



Add Ca and Tissue Factor



**Fibrin Clot
PT?
~14sec**

ProThrombin Time

INR

$$= \left(\frac{\text{PT (pat)}}{\text{PT (n)}} \right)^{\text{ISI}}$$

Diff.Lab may show diff.results, if anticoagulant being used. PT not reliable.

INR developed!
Healthy - INR:0.9-1.3
With Warfarin: 2-3

(What if INR too high or Low?)

PT (pat) = Patient

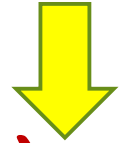
PT (n) = Normal

ISI = Internat

(the optimal ratio is 1.5 to 1.5)

Thromboembolic Conditions - VTE/PE

Immobility (orthopedic surgery)



Abnormal Clot (Thrombus) maybe formed in Leg Veins



May break and enter right heart



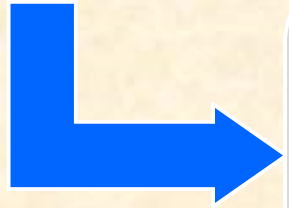
Pulmonary Artery



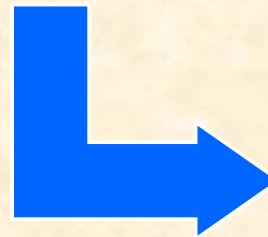
Pulmonary Embolism (PE)

Thromboembolic Conditions - DIC

Bacterial Septicaemia
Cancer cells



Imbalance b/w
thrombin generation
& anti-coagulation



Peripheral Vessels Blocked
Septicaemic Shock
↑ Platelet Consumption
↑ Clotting factor consumption

Treatment/Prevention of Abnormal Coagulation

Anti-Coagulants

▶ Heparin

▶ Warfarin

(inhibits synthesis of Vit.K dependent clotting factors - II, VII, IX, X and inhibits Protein C)

Fibrinolytic/ Thrombolytic

▶ t-PA

(may prove to be Life saver in coronary disease and Pulmonary embolism)

Bleeding Disorder

Minor Bleeding

(Mucosal)

vWF Disease

Thrombocytopenia

Major

bleeding

Haemophilia

Vit.K

Deficiency

Haemophilia A/B

Bleeding into joints/Muscle

Which is more

Prevalent?

A or B?

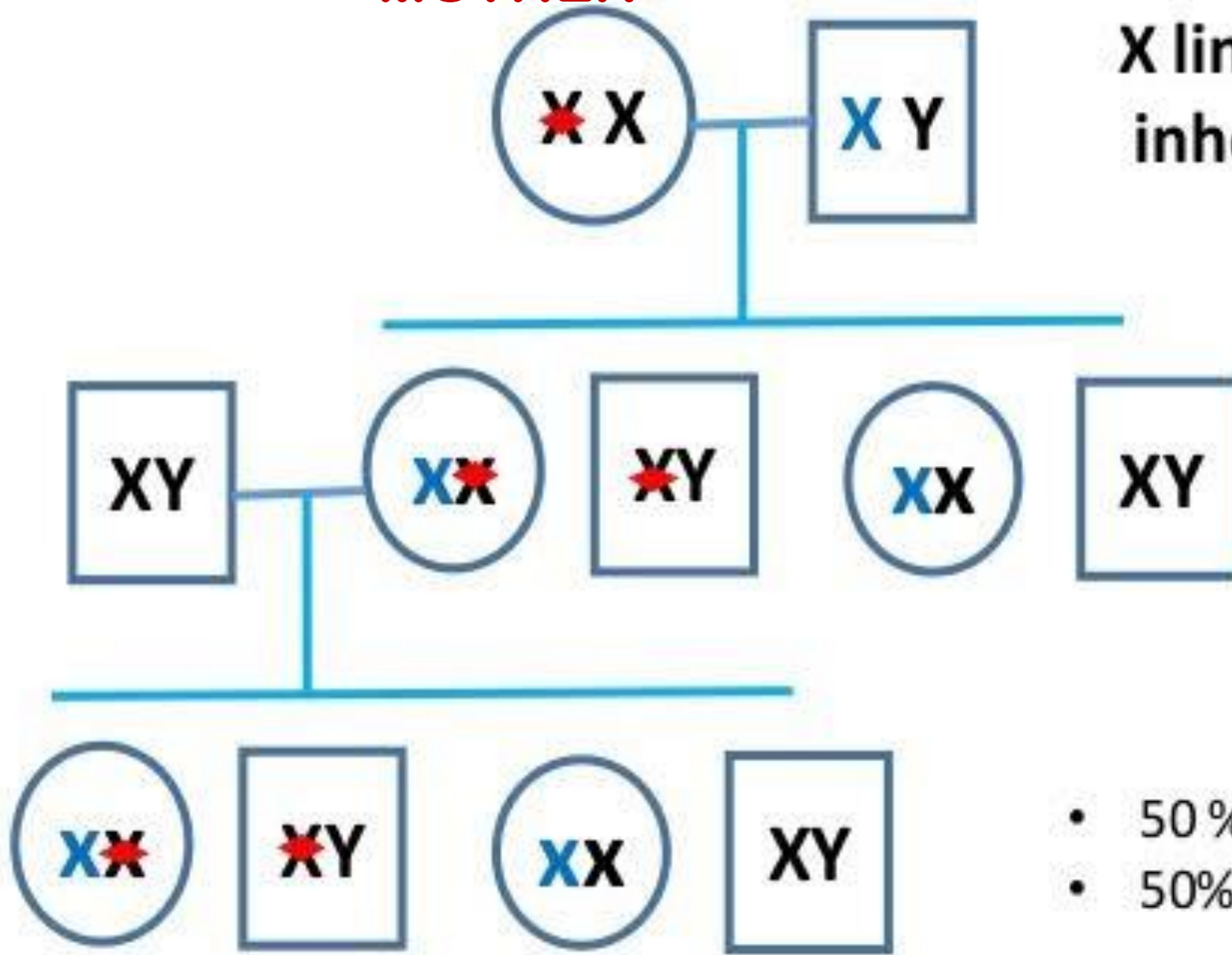
PT abnormal or

aPTT or both?

MOTHER

FATHER

X linked recessive inheritance



- 50 % of male will be affected
- 50% of female will be carrier