

Blood physiology

Tharunya Kurusanth MD5

Contents

Platelets

- Function and origin
- **Hemostasis**
 - Primary hemostasis
 - Secondary hemostasis
 - Disorders of hemostasis
 - Drugs that affect hemostasis

Red blood cells

- Function and origin
- Blood type AB0 and Rh
- Serological conflict

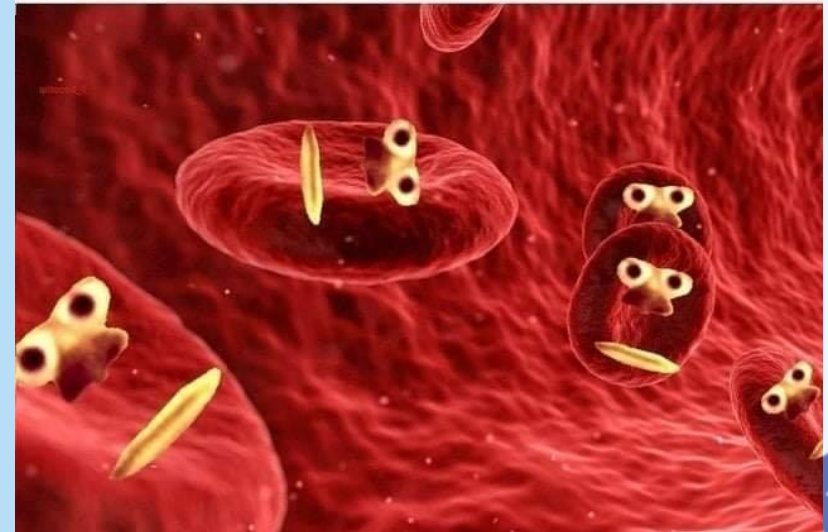
Platelets (PLT's)

- 150.000 – 400.000 cells/ μ L
- Small (2-3 μ m), anuclear
- Cell membrane: phospholipids, glycoproteins
- **Thrombopoietin** from liver (and kidney)
- Life span \approx 10 days
- \downarrow PLT = thrombocytopenia
- \uparrow PLT = thrombocytosis

Platelets: *spends hours to clot my injury*

8 y/o me: *scratches the clot because its itchy*

Platelets:



Hemostasis

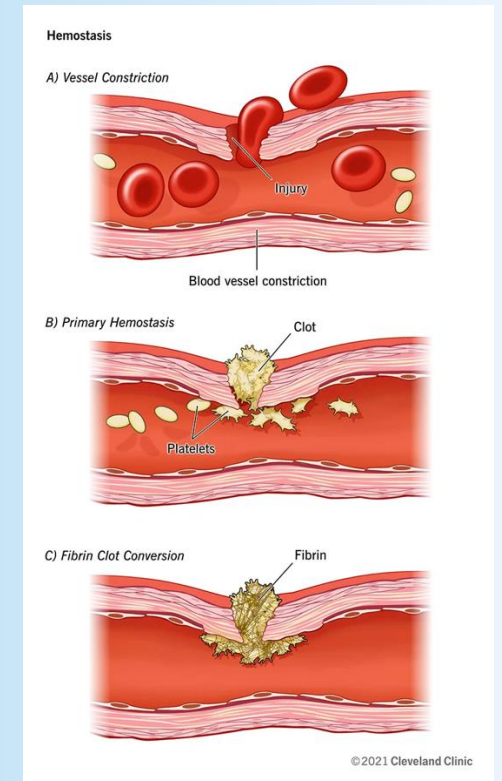
- Stopping of blood flow and prevention of blood loss

3 stages:

1. Vasoconstriction

2. Formation of temporary «platelet plug»

3. Activation of coagulation cascade and formation of «fibrin plug»



Hemostasis



	Primary	Secondary
Goal	Platelet plug	Fibrin plug
Mechanism	Vasoconstriction Platelet aggregation	Coagulation cascade
Clot characteristics	Unstable	Stable

Primary hemostasis

Vasoconstriction

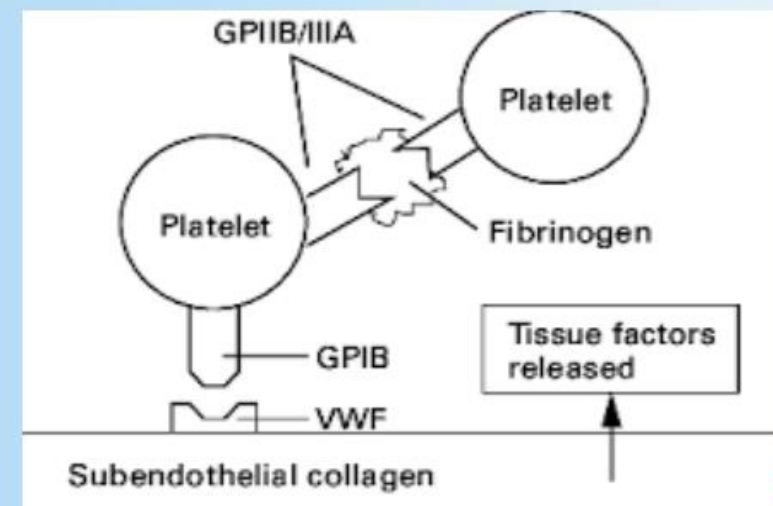
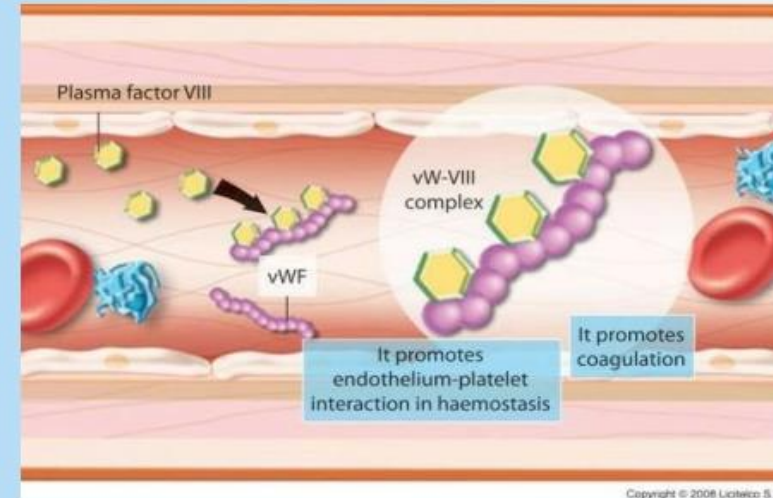
- *Damage to endothelium* →
- Sympathetic reflex
 - Arteriolar smooth muscle contraction
- Vasoconstrictors
 - Thromboxane A₂
 - Serotonin



Primary hemostasis

PLT activation

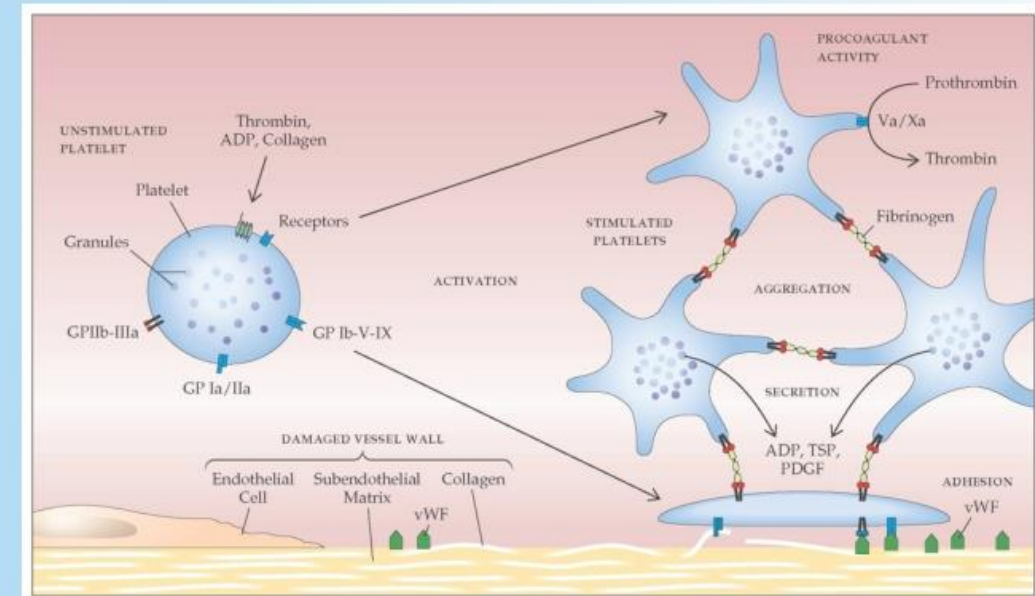
- Subendothelial collagen – PLT activation
- Release of PLT granules:
 - *TXA₂, serotonin, ADP*
 - *Activate nearby PLT's*
- *Von Willebrand factor (vWF)*
 - PLT adherence
 - GPIIB/III A
 - Clotting factor VIII



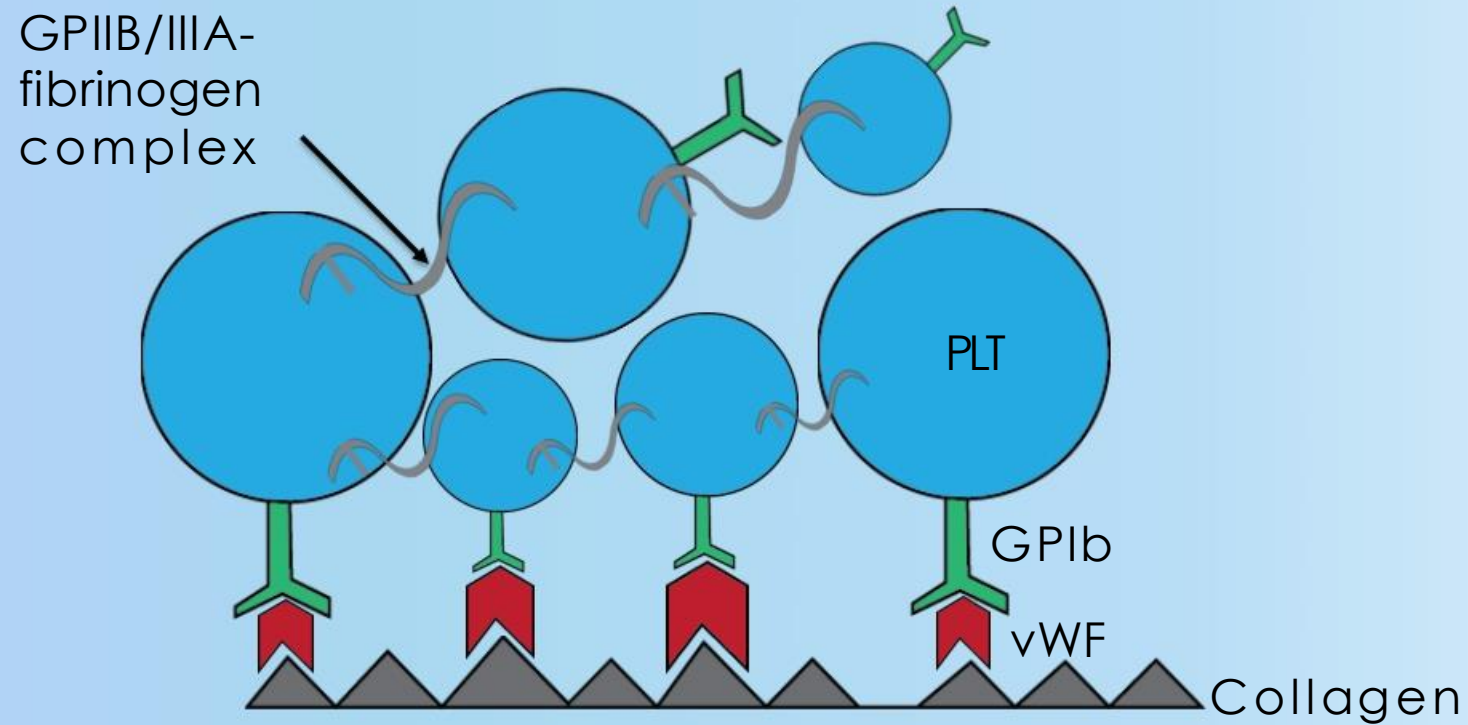
Primary hemostasis

PLT aggregation

- **ADP** - change of PLT shape, GPIIB/IIIA expression
- **Thromboxane A₂ (TXA₂)** - PLT aggregation
- **Fibrinogen** binds to GPIIB/IIIA, and ties platelets together



Product after primary hemostasis!



Contents

Platelets

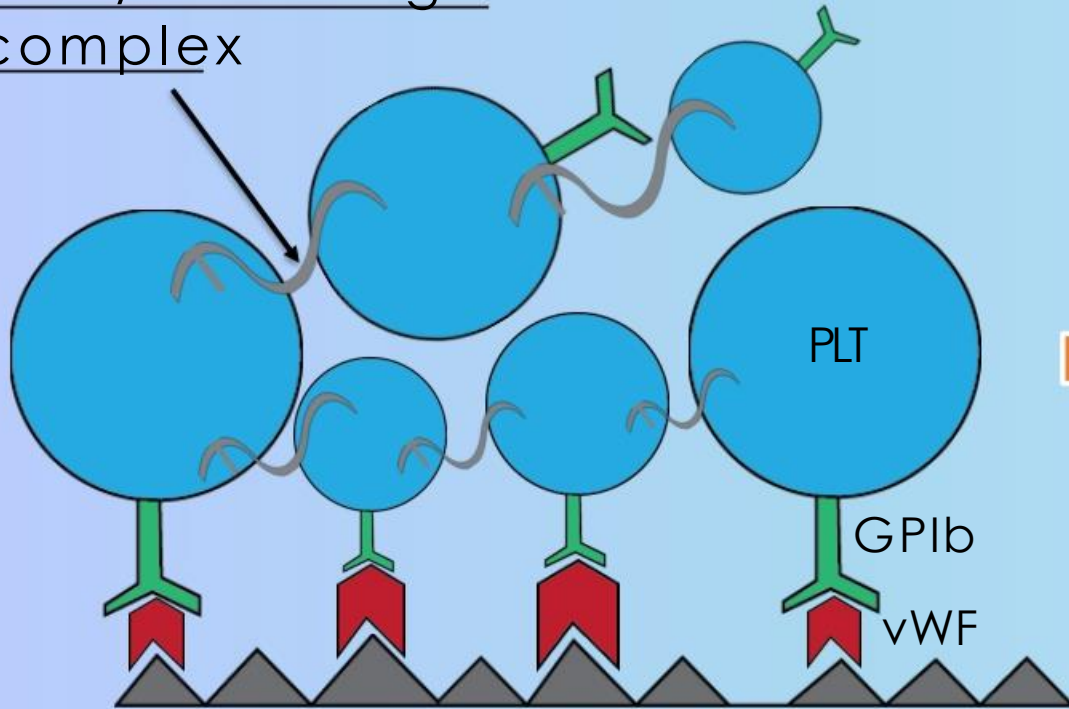
- ~~Function and origin~~
- ~~**Hemostasis**~~
 - ▶ ~~Primary hemostasis~~
 - ▶ Secondary hemostasis
 - ▶ Disorders of hemostasis
 - ▶ Drugs that affect hemostasis

Red blood cells

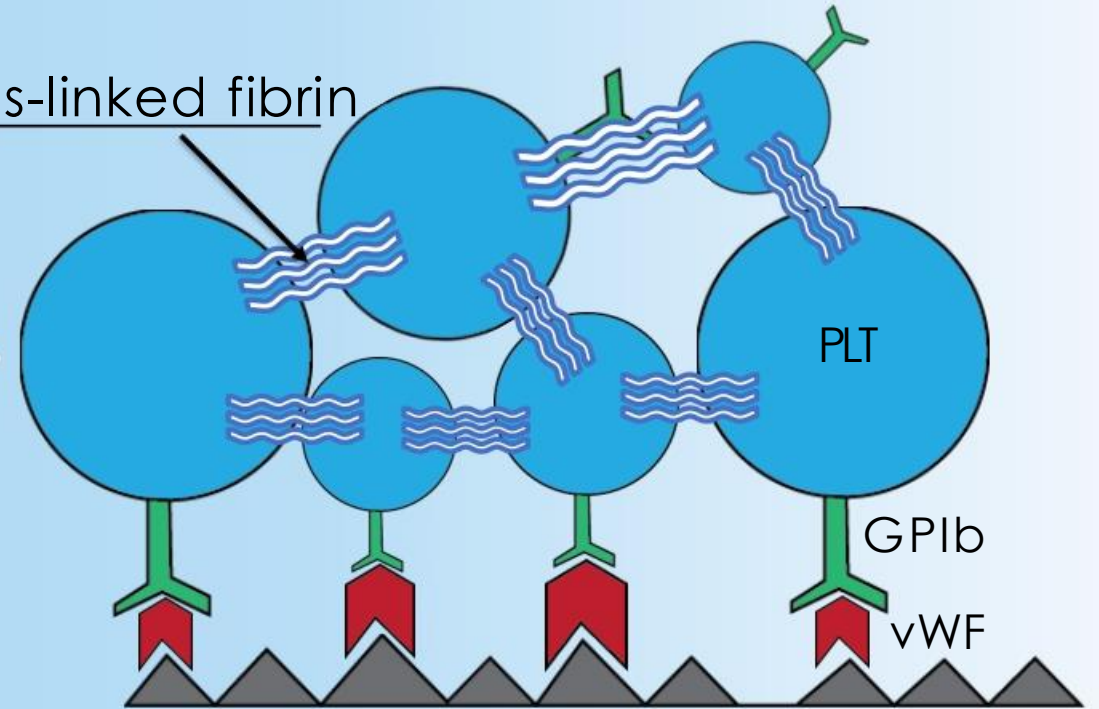
- Function and origin
- Blood type AB0 and Rh
- Serological conflict

What is the goal?

GPIIB/III A-fibrinogen complex



Cross-linked fibrin



unstable

Collagen

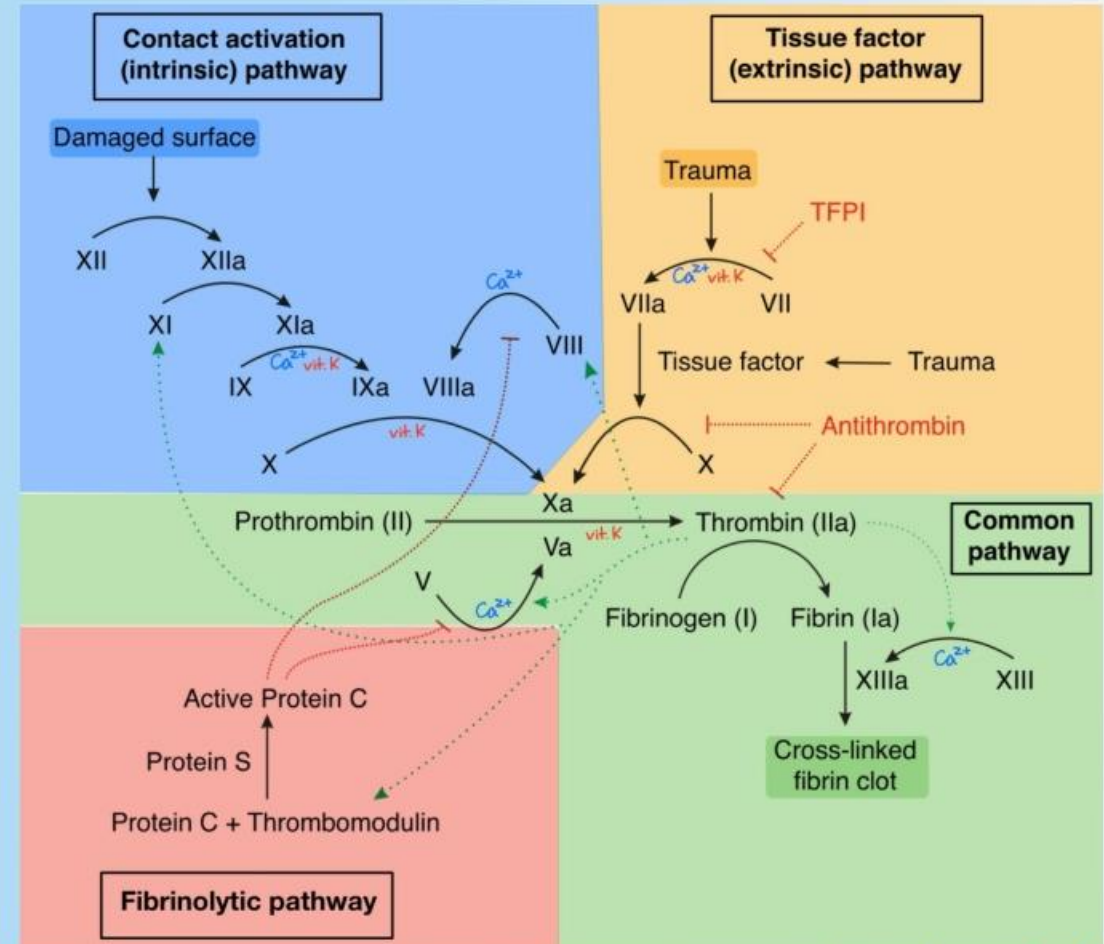
stable

Secondary hemostasis

Coagulation cascade

4 pathways:

- Intrinsic pathway
- Extrinsic pathway
- Common pathway
- (Fibrinolytic pathway)



Coagulation cascade

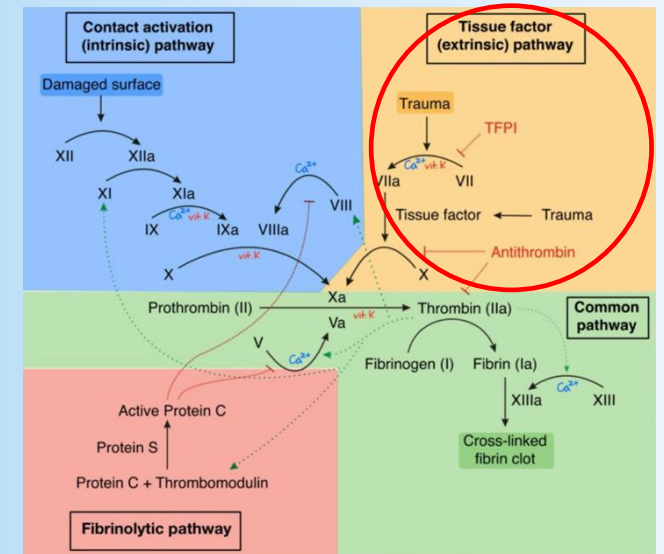
Extrinsic pathway

external trauma

tissue factor (3) (thromboplastin)



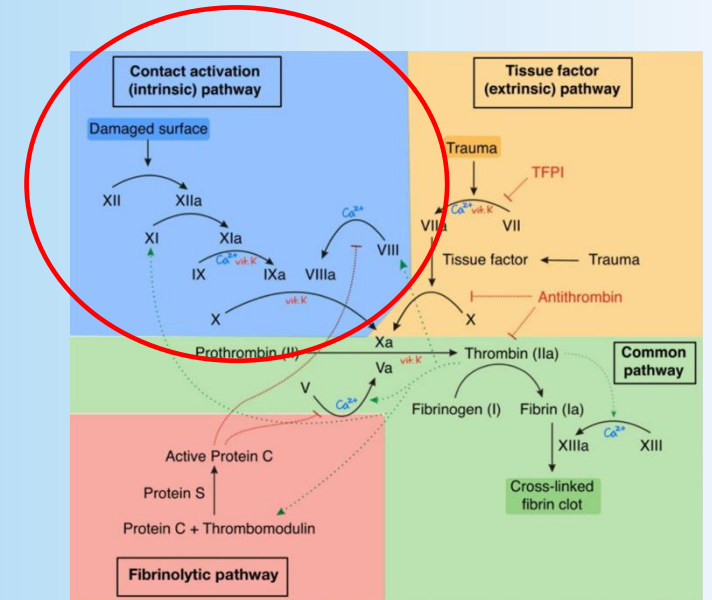
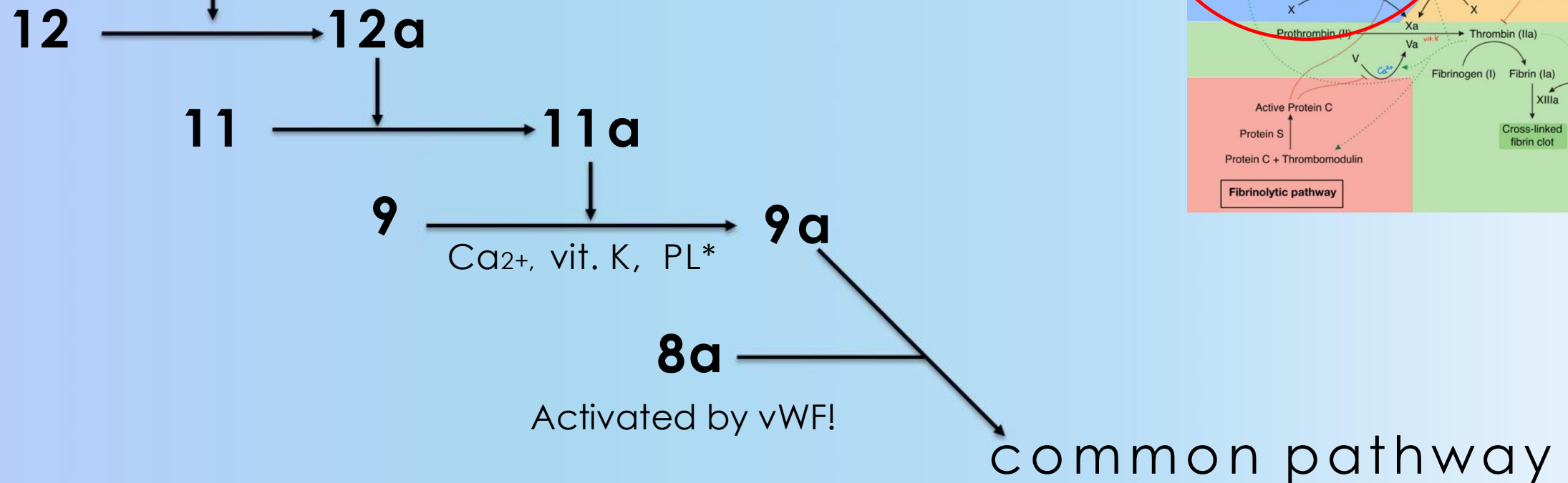
common pathway



Coagulation cascade

Intrinsic pathway

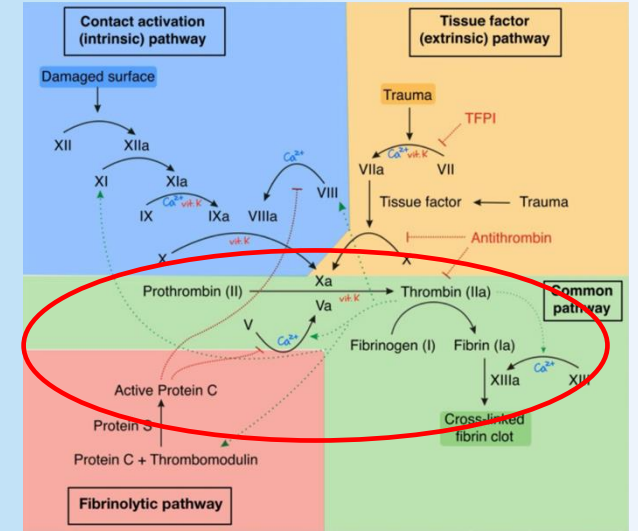
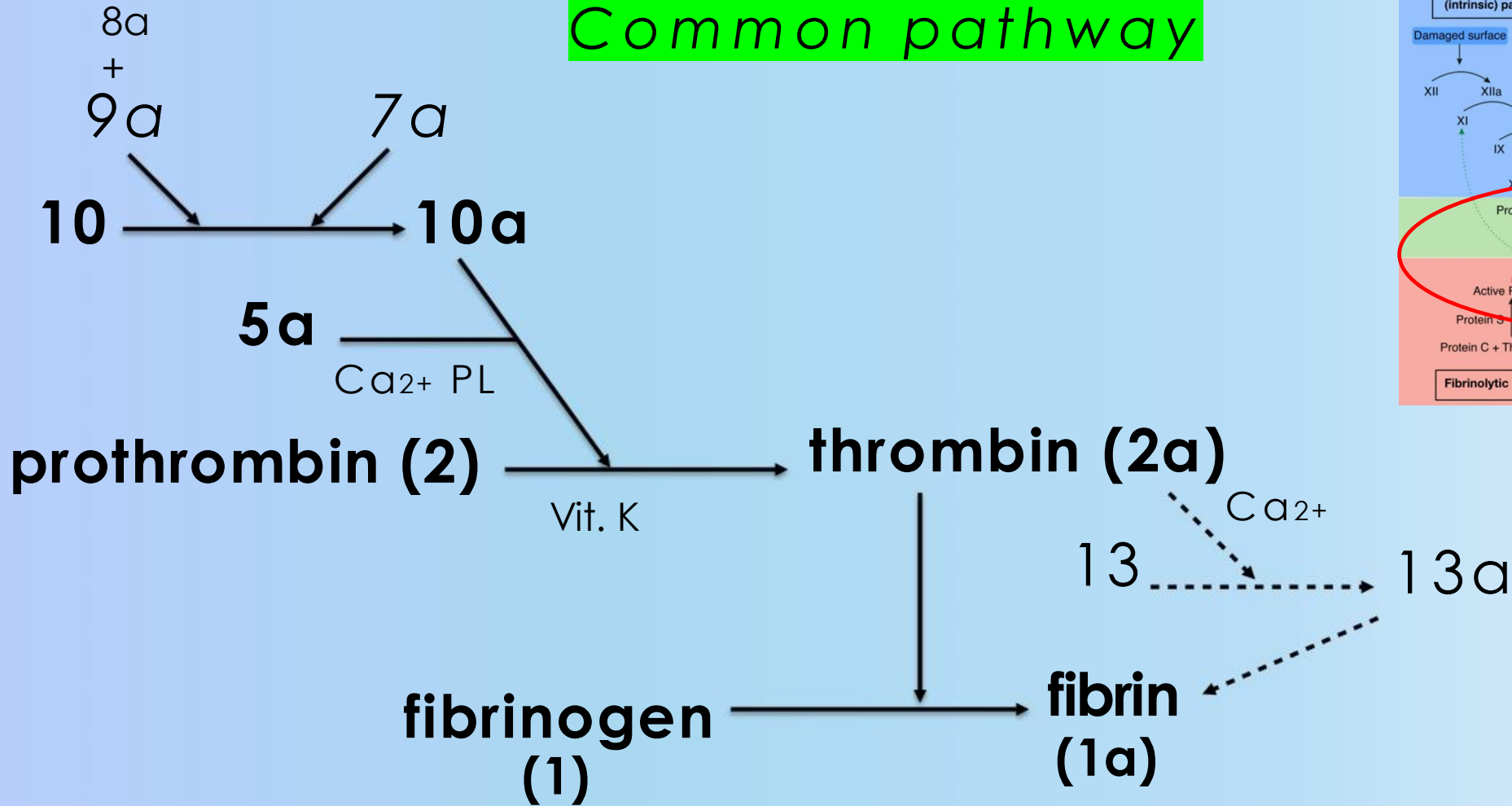
Collagen (*internal wall*)



*PL = platelet phospholipids

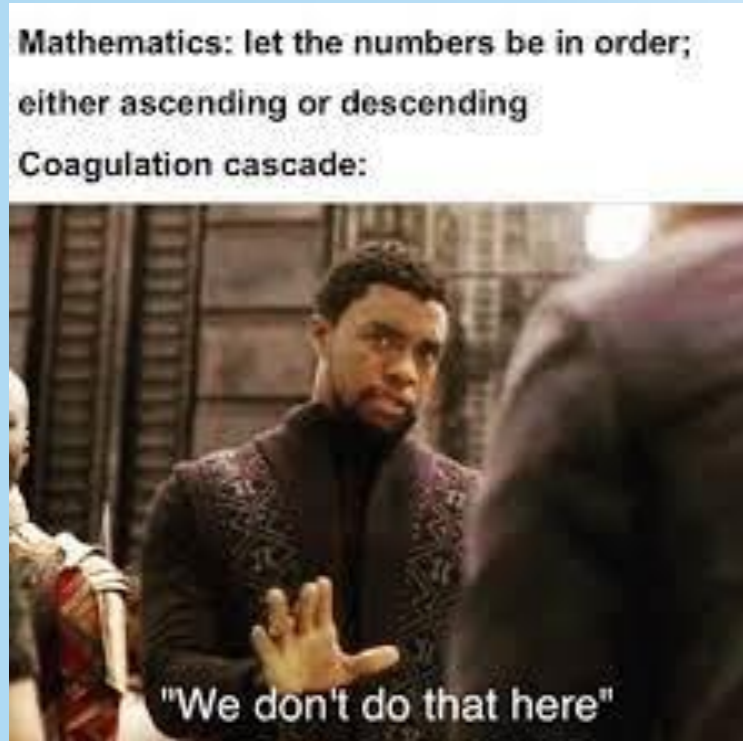
Coagulation cascade

Common pathway



Clotting factors

1. *Fibrinogen*
2. *Prothrombin*
3. *Tissue factor*
4. *Calcium*
5. Labile factor (proaccelarin)
7. *Stabile factor*
8. *Anti-haemophilic factor*
9. *Christmas factor*
10. *Stuart - Prower factor*
11. *PTA (plasma thromboplastin antecedent)*
12. *Hageman factor*
13. *Fibrin stabilizing factor*

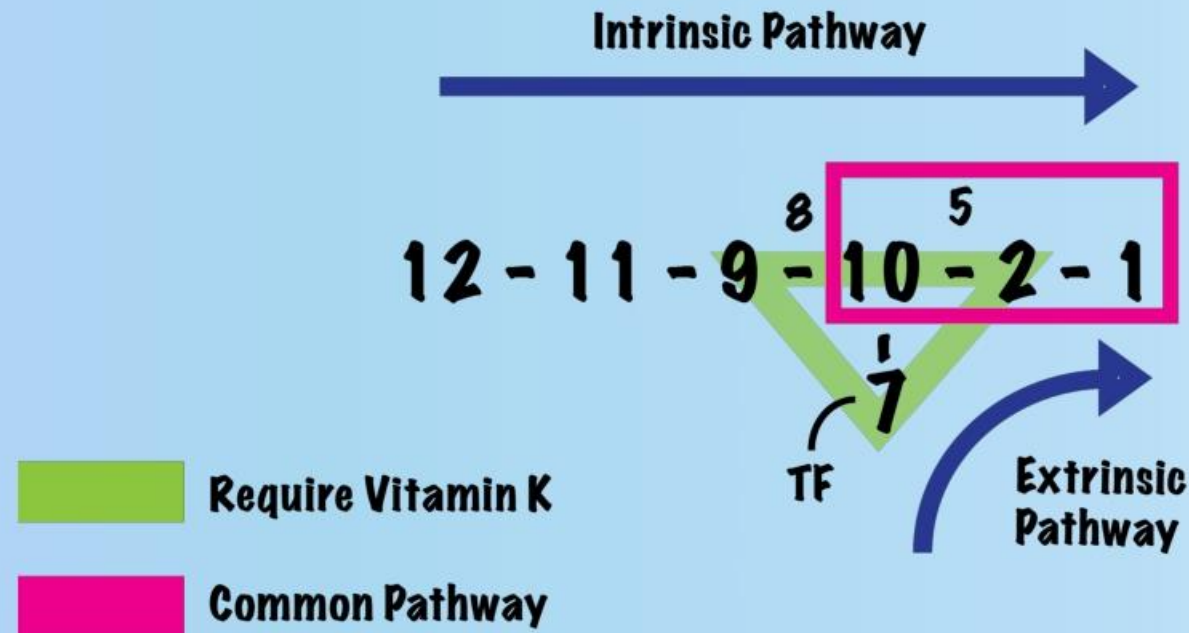


Foolish People Try Climbing Long Slopes After Christmas, Some People Have Fallen

Secondary hemostasis

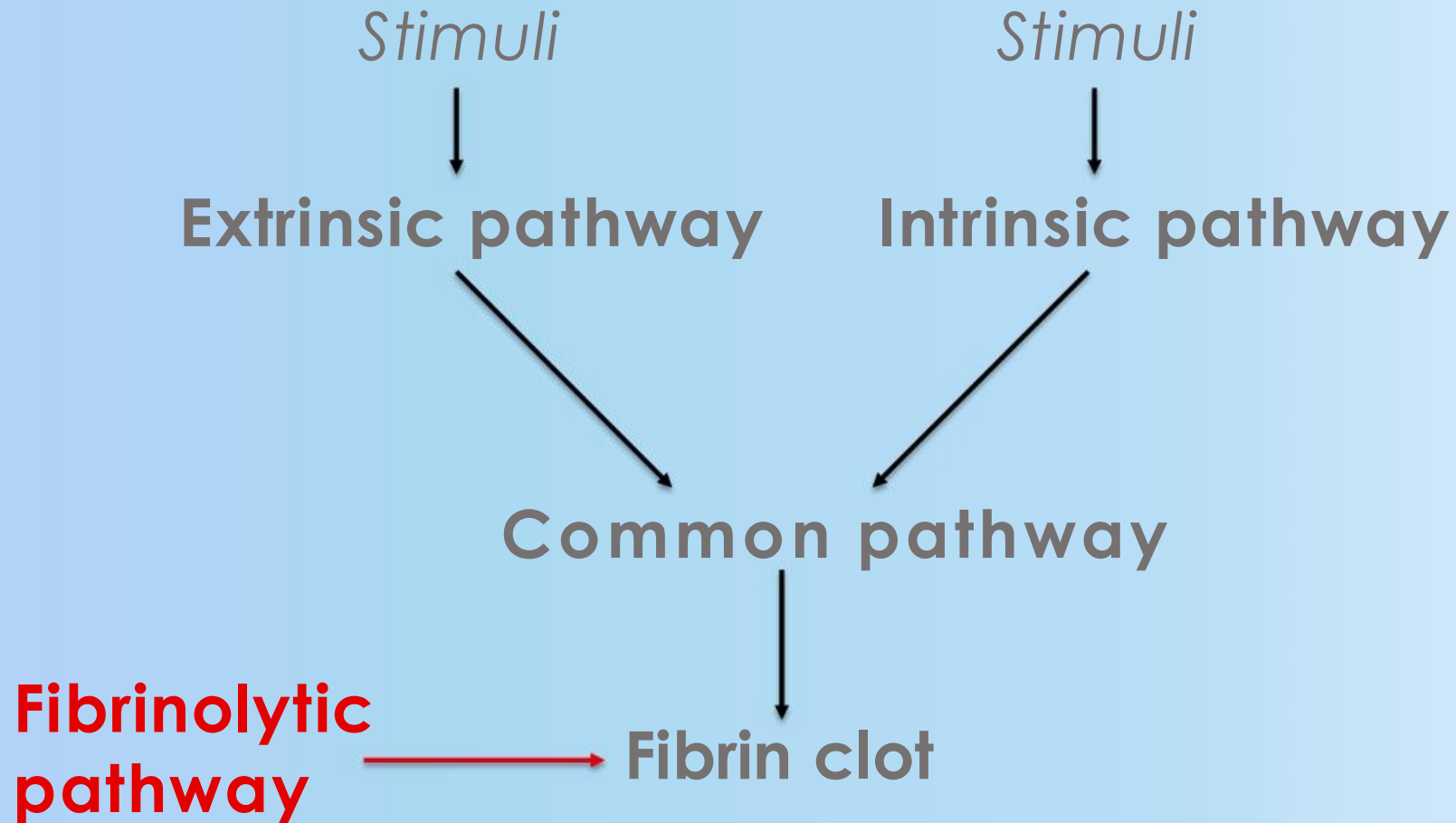
Coagulation cascade

Vit. K dependent <ul style="list-style-type: none">• 10, 9, 7 & 2▸ «1972»	Synthesized in liver <ul style="list-style-type: none">• 1, 2, 5, 7, 8, 9, 10, 11, 12• Protein C	Ca²⁺ dependent <ul style="list-style-type: none">• 5, 7, 8, 9 & 13
---	--	--



Coagulation cascade

Fibrinolytic pathway

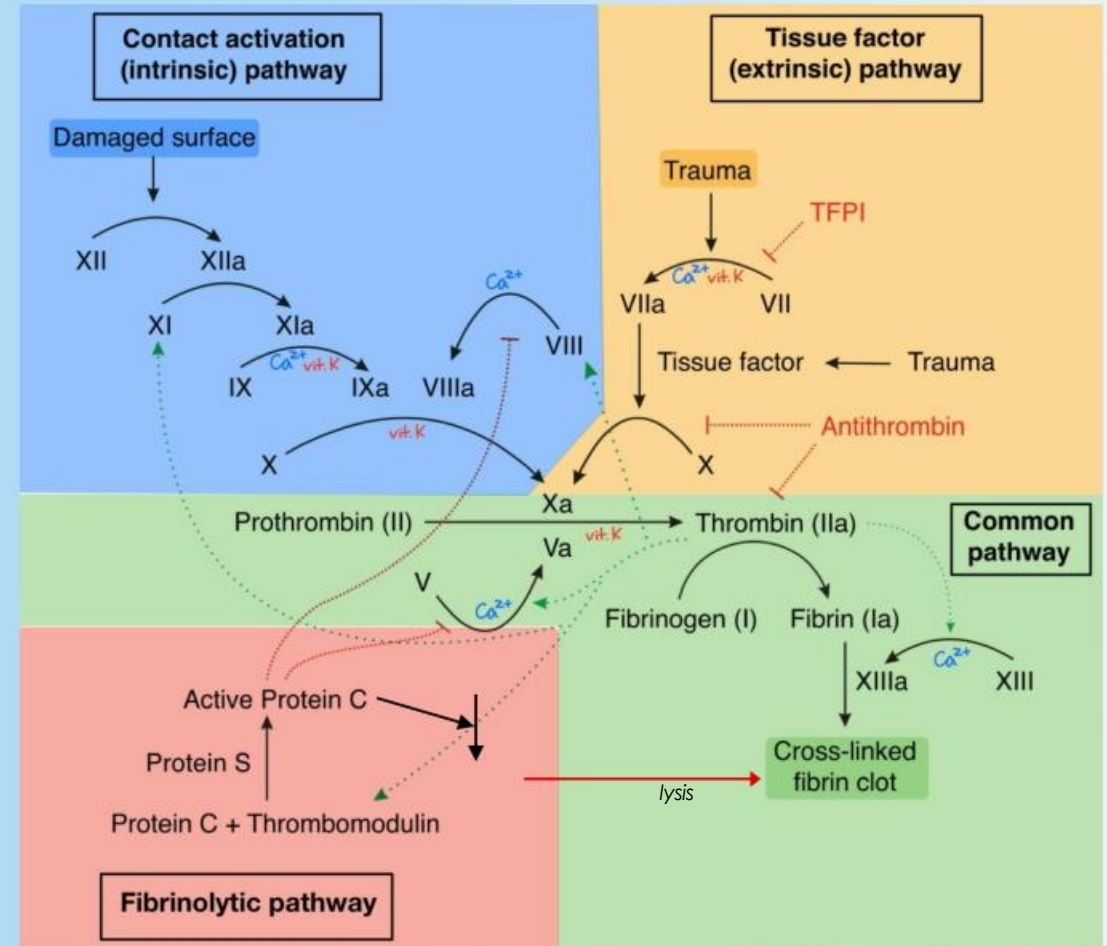


Coagulation cascade

Fibrinolytic pathway

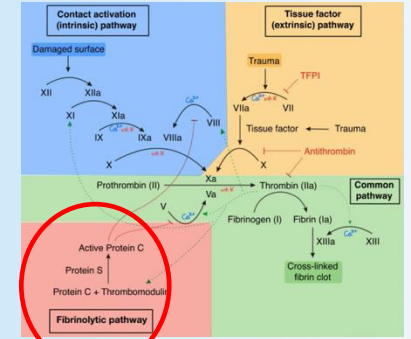
Goal:

- Destroy pre-existing clots:
thrombolysis
- Stop new clots from forming:
anticoagulation



Coagulation cascade

Fibrinolytic pathway



Thrombin (2a)

Thrombin-thrombomodulin complex

Thrombomodulin

Protein C

APC

t-P A

8

Plasminogen

Plasmin

5

lyses fibrin

Contents

Platelets

- ~~Function and origin~~
- ~~**Hemostasis**~~
 - ▶ ~~Primary hemostasis~~
 - ▶ ~~Secondary hemostasis~~
 - ▶ Disorders of hemostasis
 - ▶ Drugs that affect hemostasis

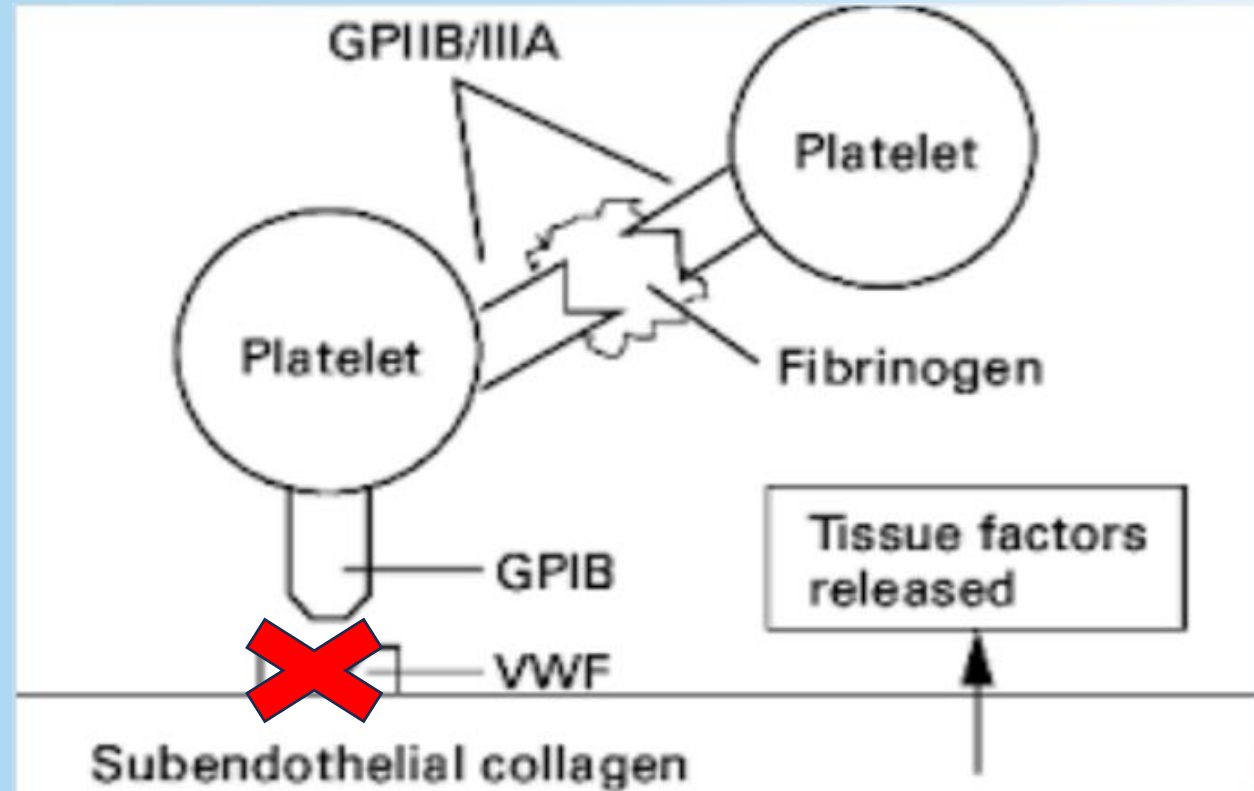
Red blood cells

- Function and origin
- Blood type AB0 and Rh
- Serological conflict

Clotting disorders – von Willebrand disease

- ↓vWf or no vWf
- Primary hemostasis

Ppl w/ vWD Nosebleeds



Clotting disorders – secondary hemostasis

Hemophilia A

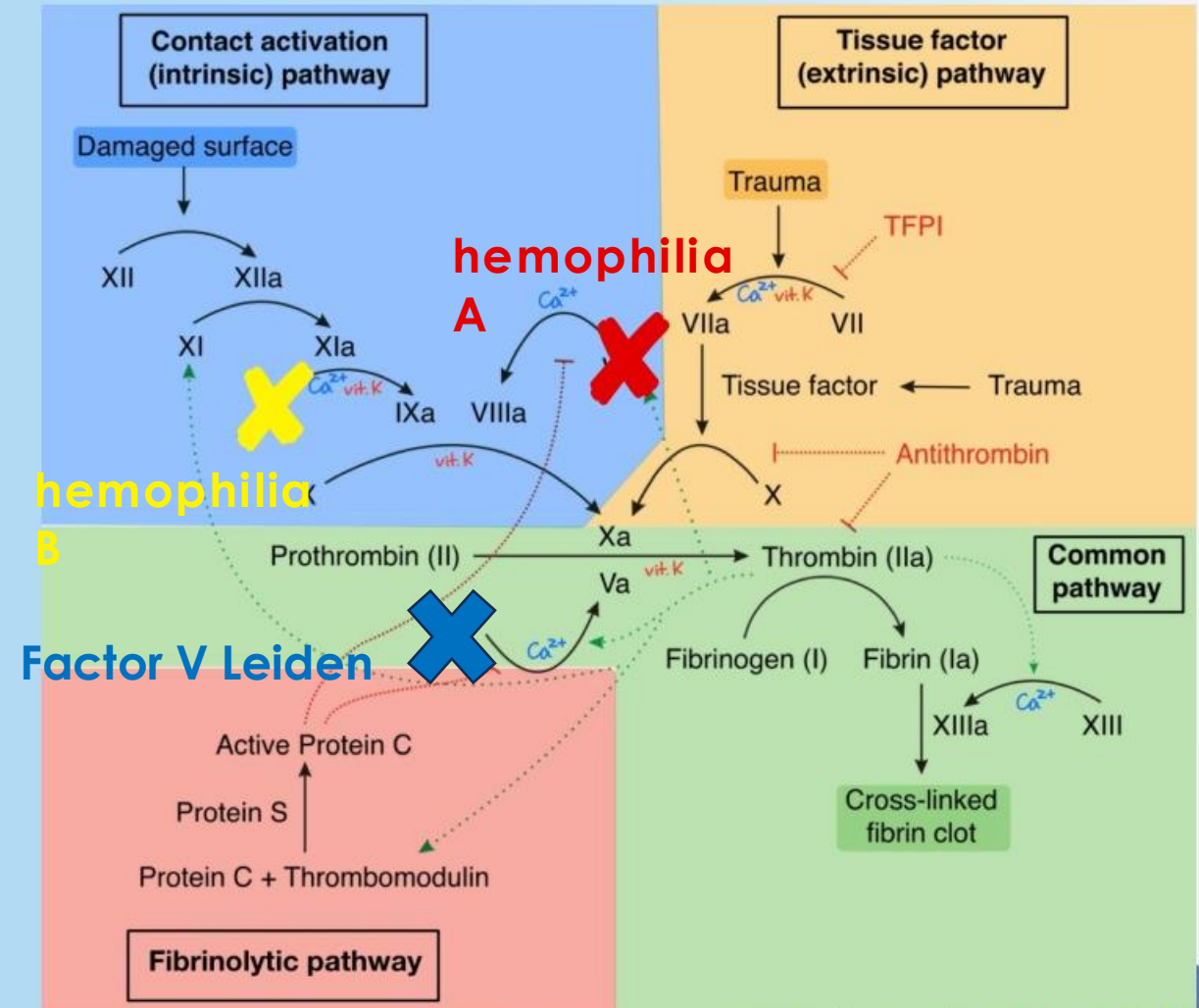
- Deficiency of **clotting factor 8**
«*hemophilia Aight*»

Hemophilia B

- Deficiency of **clotting factor 9**

Factor V Leiden

- Mutation of **clotting factor 5**

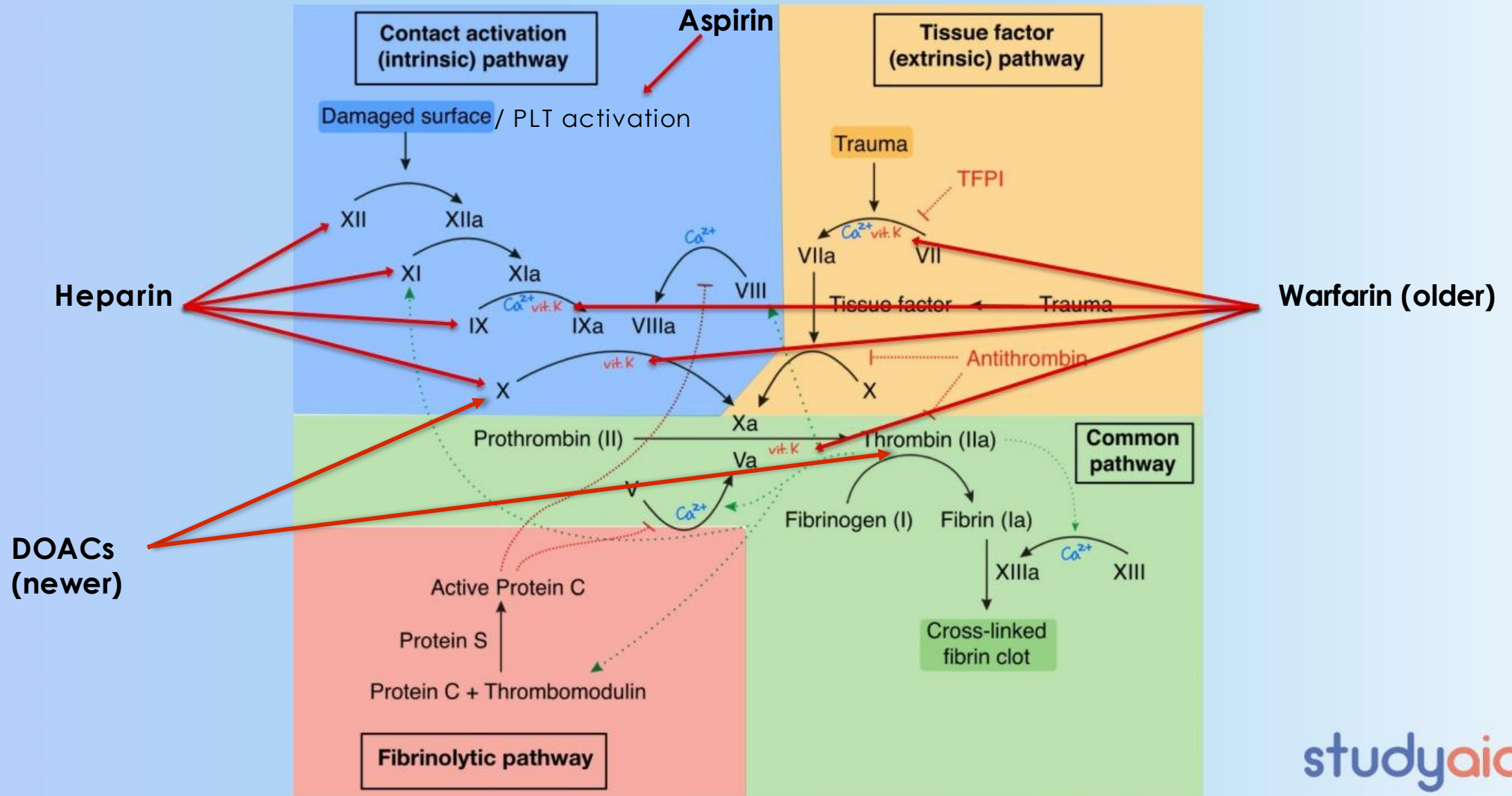




Clotting disorders

	Haemophilia	Von Willebrand disease	Factor V leiden	Vitamin K deficiency
Disorder type	Hypocoagulative state of secondary hemostasis	Hypocoagulative state of primary hemostasis	Hypercoagulative state of secondary hemostasis	Hypocoagulative state of secondary hemostasis
Pathophysiology	Hemophilia A: Deficiency of factor VIII Hemophilia B: deficiency of factor IX	Deficiency of vWF	Mutation of factor V	Insufficient activation of clotting factors 2, 7, 9 & 10
Mechanism	X-linked recessive inheritance	Autosomal dominant inheritance	Inherited	Liver disease Malabsorption Warfarin overdose

Drugs that inhibit clotting





Drugs that inhibit clotting

	LMW Heparin	Aspirin	Warfarin
Effect	Anticoagulant	Antiplatelet	Anticoagulant
Mechanism of action	When conjugated with antithrombin-III, inhibits factor IX, X, XI, XII	Inhibits synthesis of TXA ₂	Inhibits vitamin K
Used in	<ul style="list-style-type: none">- Always present in blood- Thromboembolism	<ul style="list-style-type: none">- Heart attack- Cardiovascular diseases	Hypercoagulative disorders

Contents

~~Platelets~~

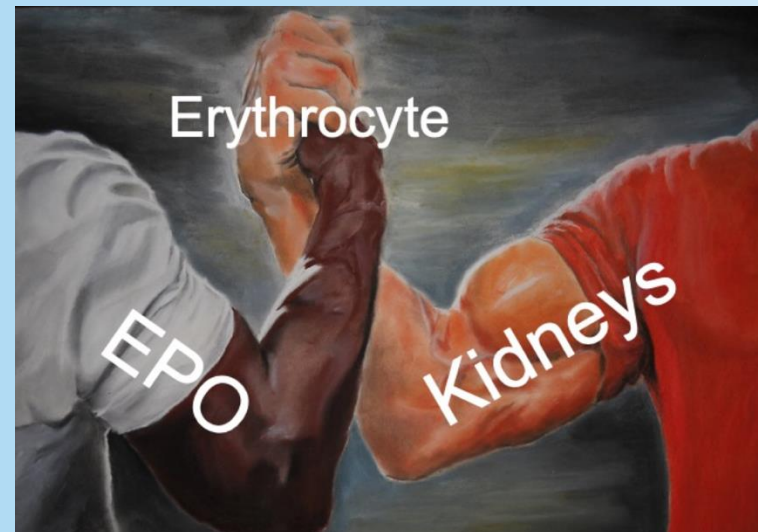
- ~~• Function and origin~~
- ~~• **Hemostasis**~~
 - ~~▶ Primary hemostasis~~
 - ~~▶ Secondary hemostasis~~
 - ~~▶ Disorders of hemostasis~~
 - ~~▶ Drugs that affect hemostasis~~

Red blood cells

- Function and origin
- Blood type ABO and Rh
- Serological conflict

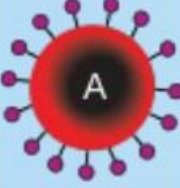
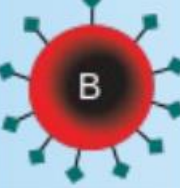
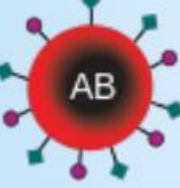




Red blood cells (RBC's)

- 4 - 6 million cells per microliter
- 6–8 μm , anuclear
- Stimulated by **erythropoietin** from the **kidney**
- Life span \approx 120 days
- Function: **oxygen transport**
- \downarrow RBCs/HgB = anemia
- \uparrow RBCs/HgB = polycythemia



Blood types




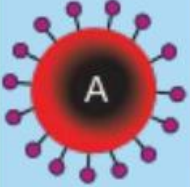
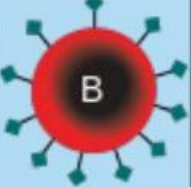
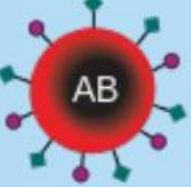




- Blood type **A**, **B**, **AB** or **O** - proteins are present/absent RBC surface
- Antibodies against the proteins that are **absent**
 - Type A = antibody B
 - Type B = antibody A
 - Type O = antibody A and B
- Rhesus proteins: **+** **or** **-**

	Group A ●	Group B ◆	Group AB ◆●	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B

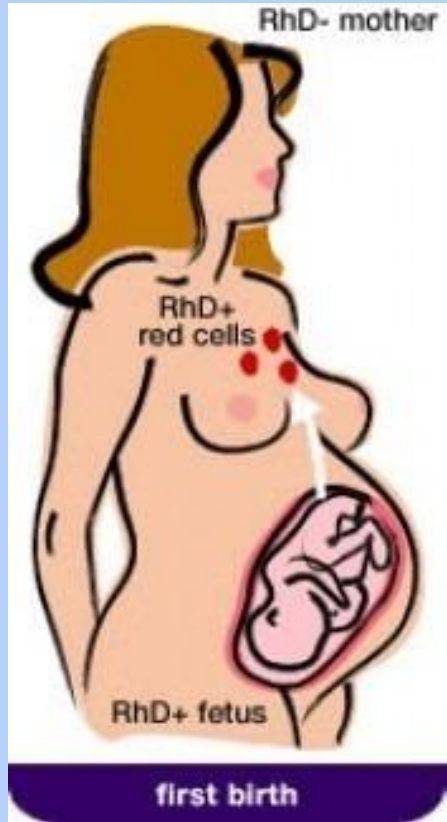
Blood types

Blood transfusion

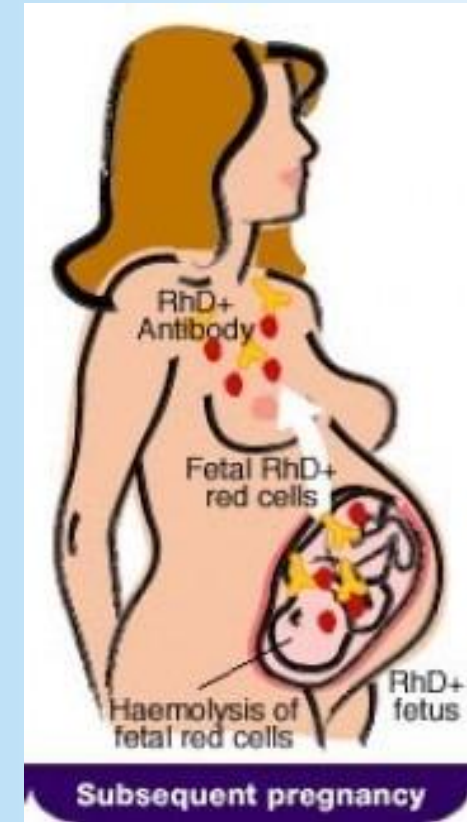
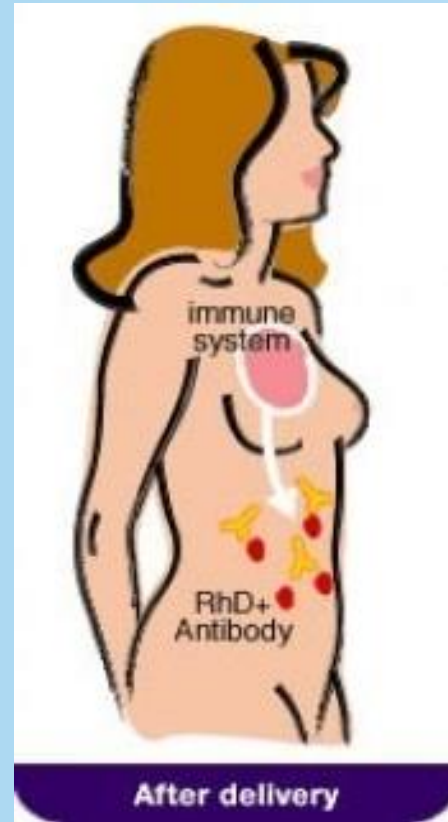
- Blood type AB+ = universal recipient
- Blood type O- = universal donor

	Group A 	Group B 	Group AB 	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B

Serological conflict



During birth: maternal and fetal blood mix!



Rh- mother,
Rh+ baby

Hemolytic disease of the newborn → Jaundice, anemia

Serological conflict - prophylaxis

- Rh blood typing at prenatal screening
- Anti-D immunoglobulin <72 hrs!!!



Thank you! 😊

