Blood Coagulation Basics

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PRECISION | INNOVATION | COMPASSION

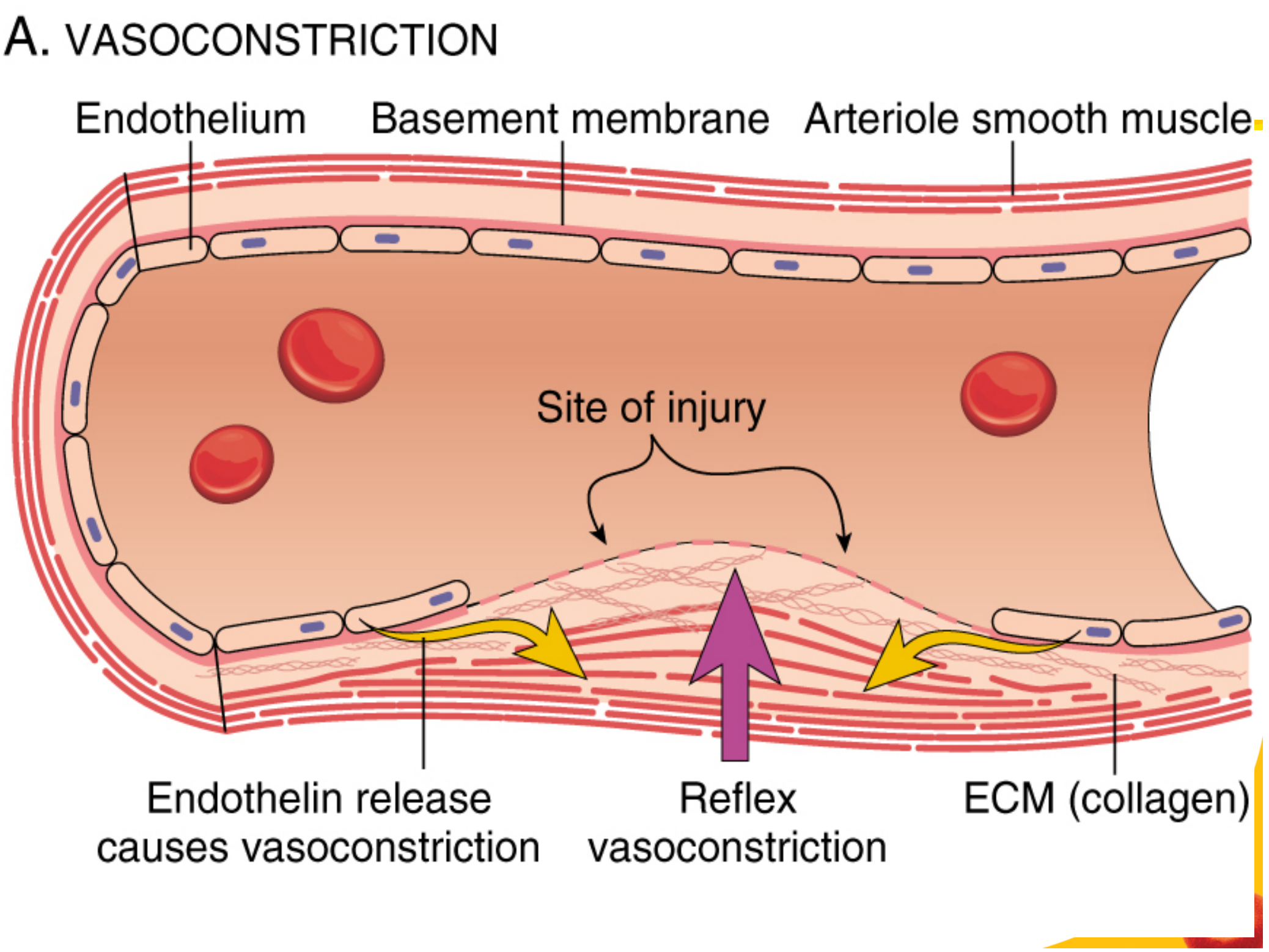
Basic Coagulation Profile

- Bleeding Time
- Platelet Count
- **Prothrombin Time (PT)**
- **Activated partial Thromboplastin Time (APTT)**
- Thrombin Time
- Fibrinogen Assays

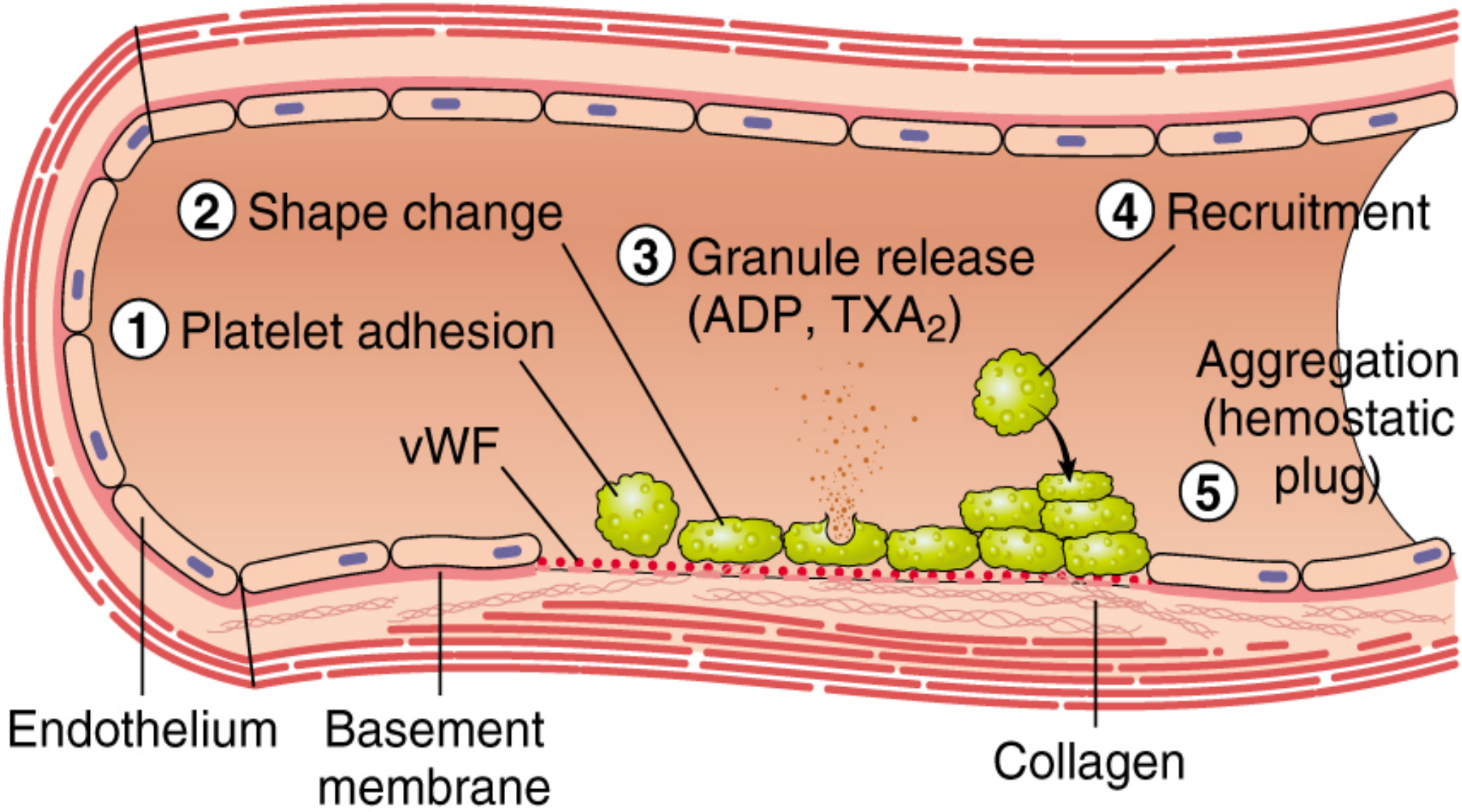
Hemostasis

- Hemostasis (“hemo”=blood; stasis= remain”) is the stoppage of bleeding, which is vitally important when blood vessels are damaged.

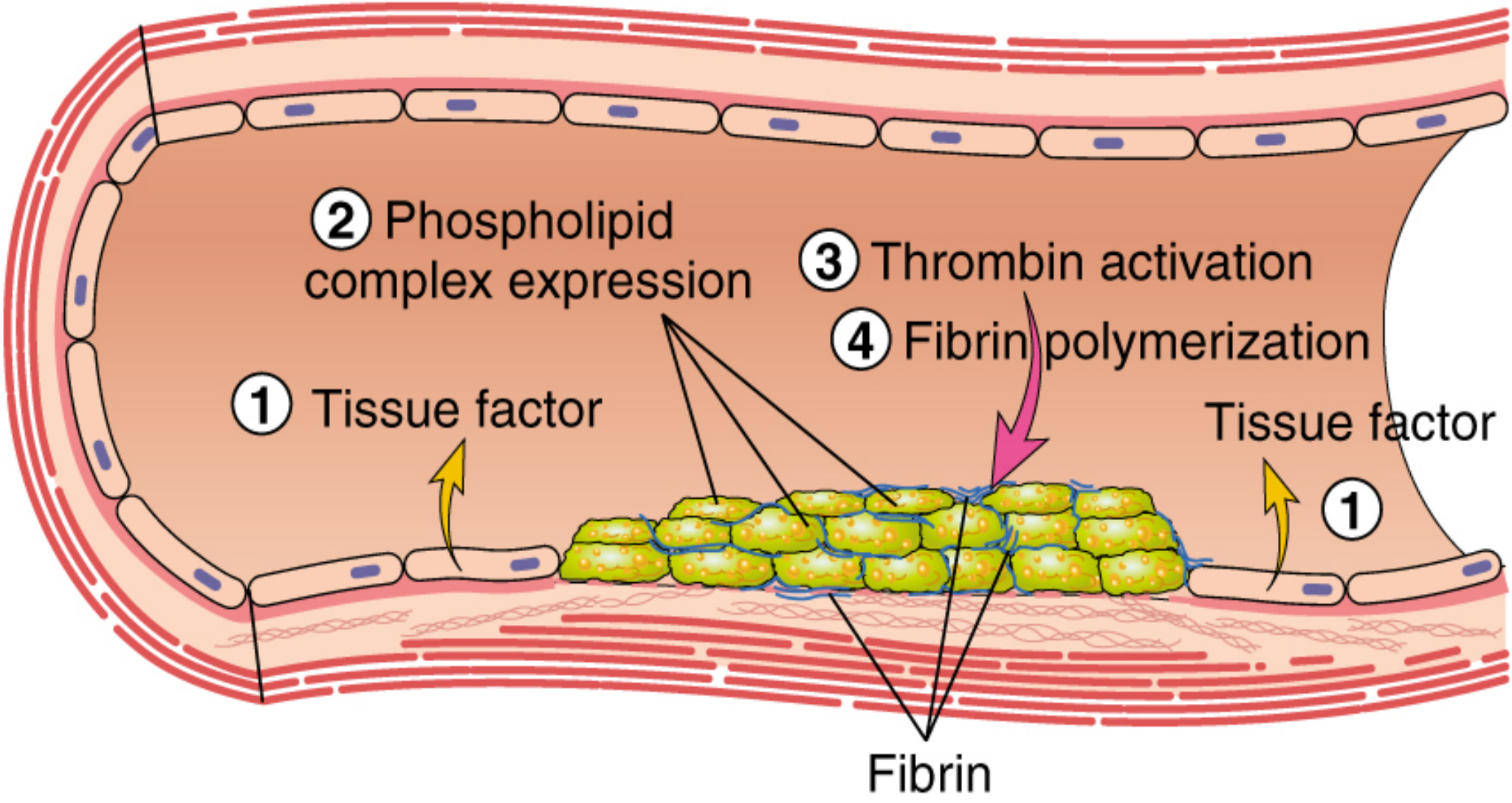
- Three steps:
  - Vasoconstriction
  - Primary Hemostasis- Platelet Plug formation
  - Secondary Hemostasis- Coagulation cascade activation leading to stable Clot formation


A. VASOCONSTRICTION
Endothelium
Basement membrane
Arteriole smooth muscle
Site of injury
Endothelin release causes vasoconstriction
Reflex vasoconstriction
ECM (collagen)

B. PRIMARY HEMOSTASIS

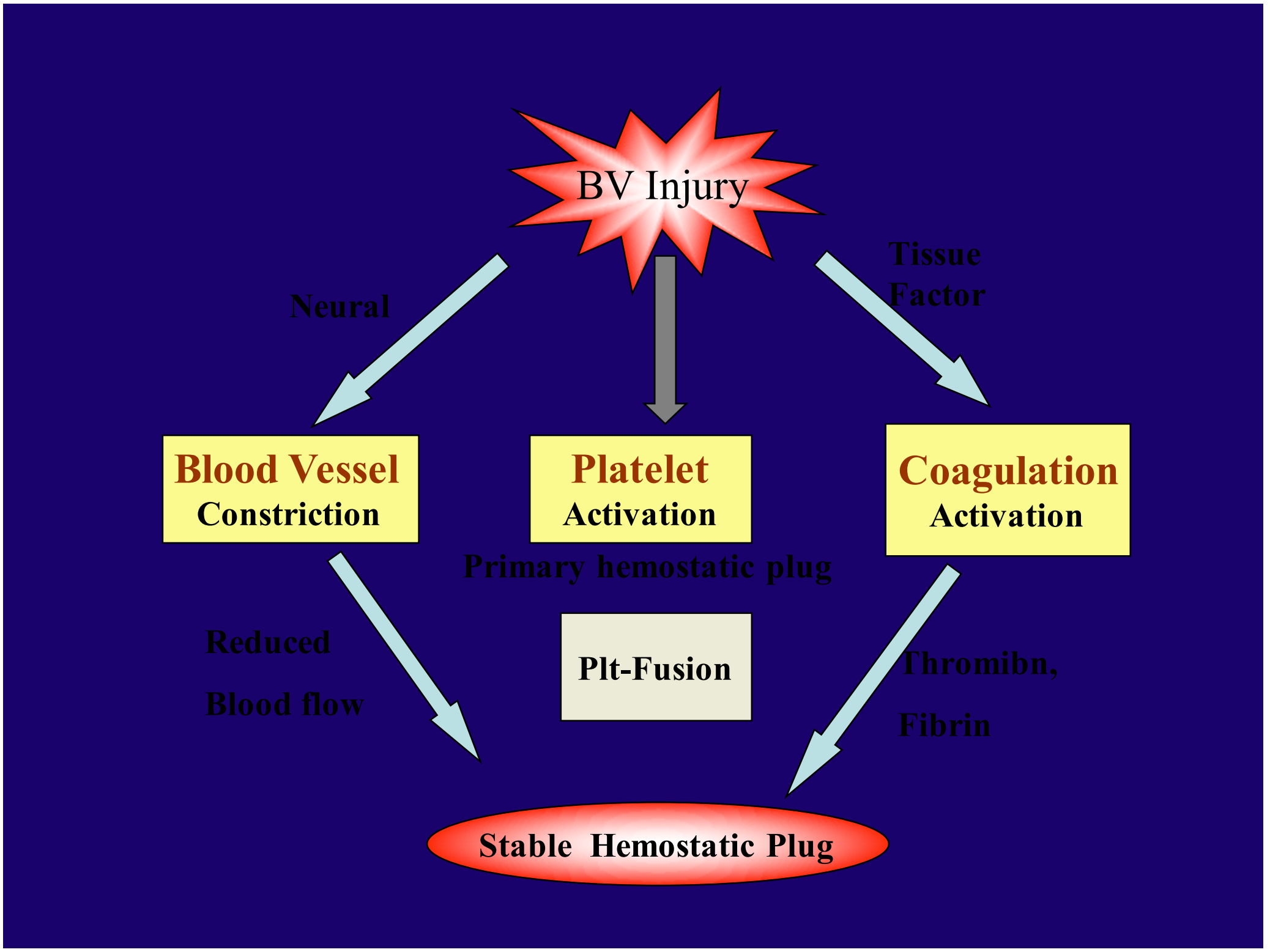


C. SECONDARY HEMOSTASIS



CLOTTING FACTORS

- I (fibrinogen
- **II (prothrombin)**
- Tissue factor
- Calcium (Factor IV)
- V (proaccelerin, labile factor)
- VI
- VII (stable factor)
- **VIII (antihemophilic factor)**
- IX (Christmas factor)
- X (Stuart-Prower factor)
- XI (plasma thromboplastin antecedent)
- XII (Hageman factor)
- XIII (fibrin-stabilizing factor)
- von Willebrand factor


BV Injury
Neural
Tissue Factor
Blood Vessel
Constriction
Platelet
Activation
Coagulation
Activation
Primary hemostatic plug
Reduced
Blood flow
Plt-Fusion
Thromibn,
Fibrin
Stable Hemostatic Plug

Coagulation made easy

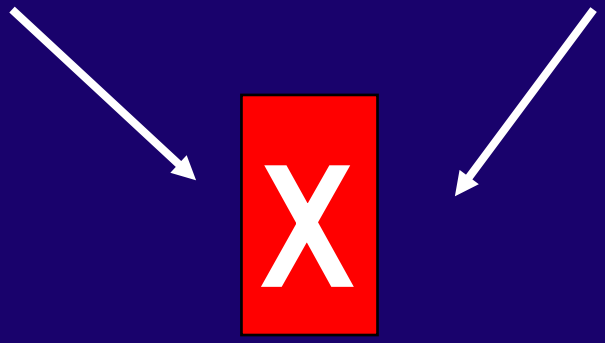
Intrinsic Pathway

Extrinsic Pathway

Coagulation made easy

The PTT Pathway
Intrinsic

The PT Pathway
Extrinsic



The PT and the PTT pathway meet at factor X, because “X” marks common pathway

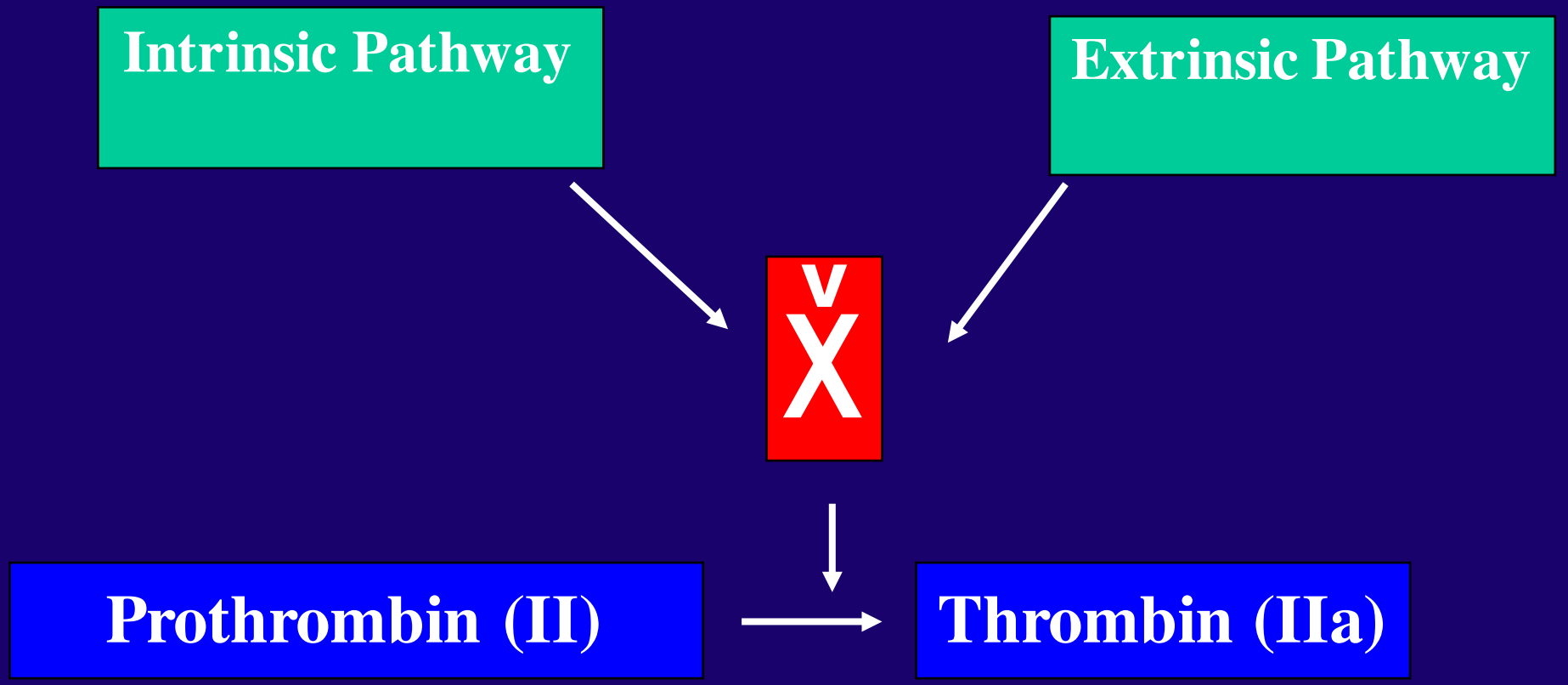
Coagulation made easy

The PTT Pathway
Intrinsic

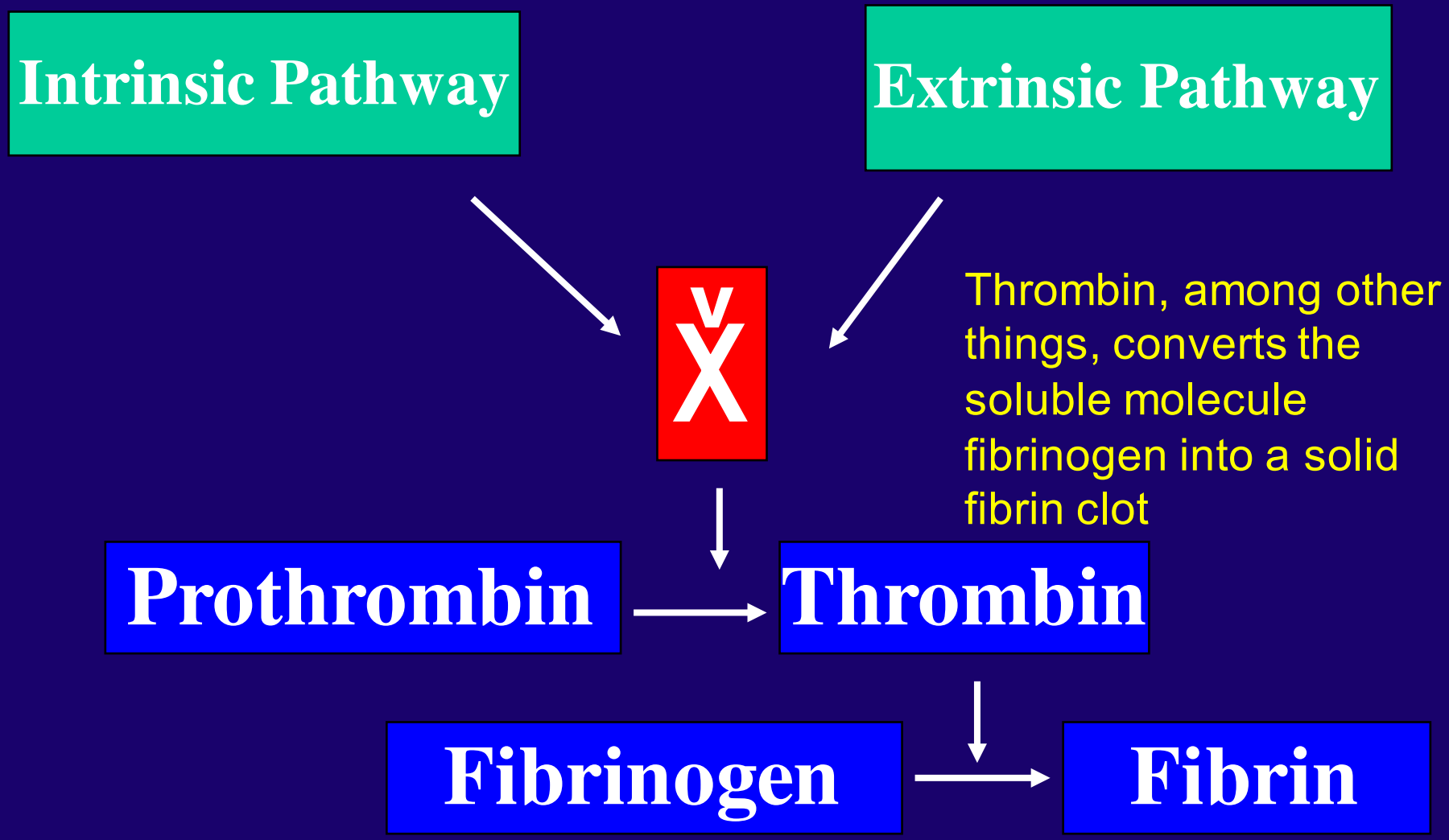
The PT Pathway
Extrinsic

Ca^{++} ,Phospholipid

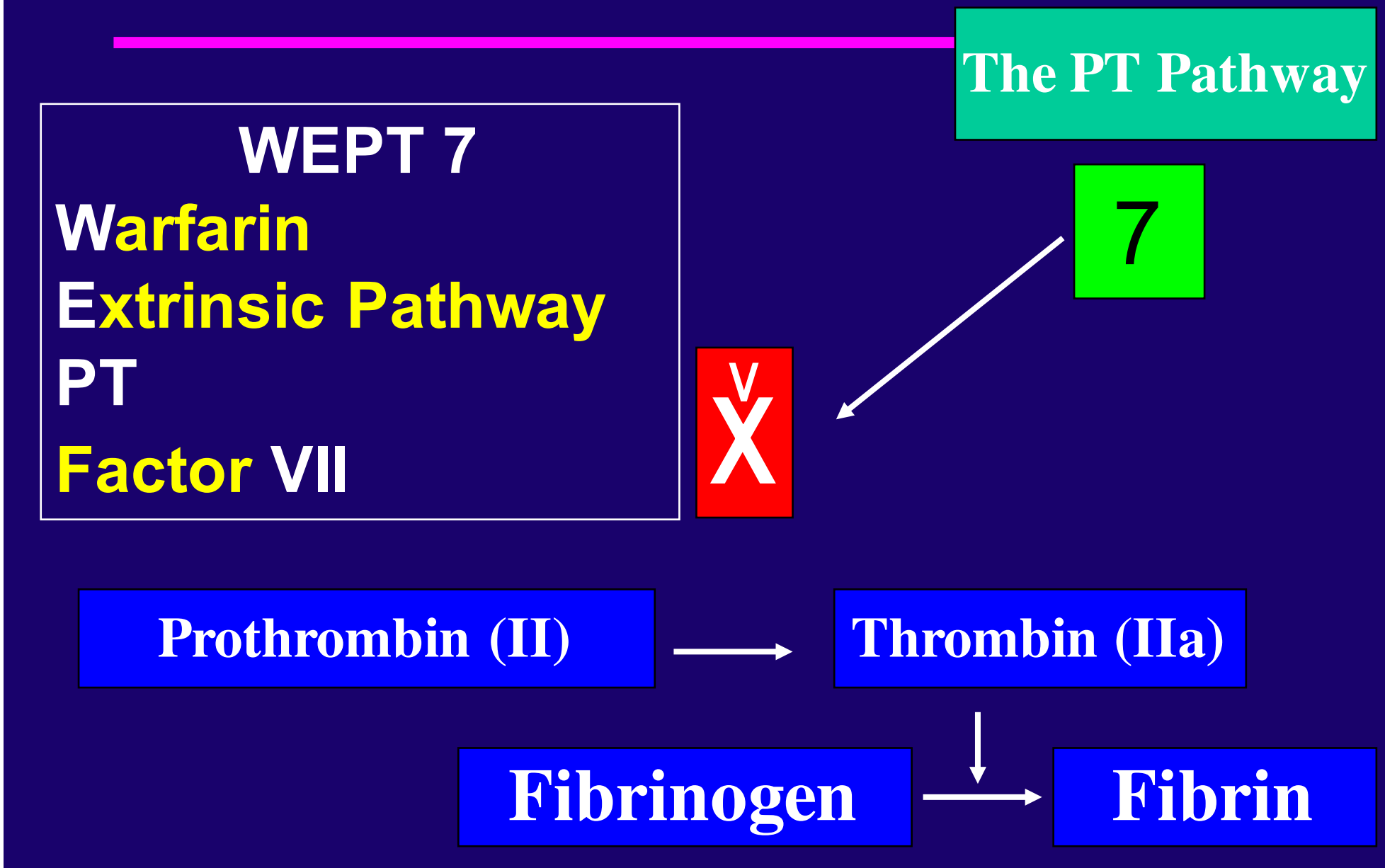
Coagulation made easy



Coagulation made easy

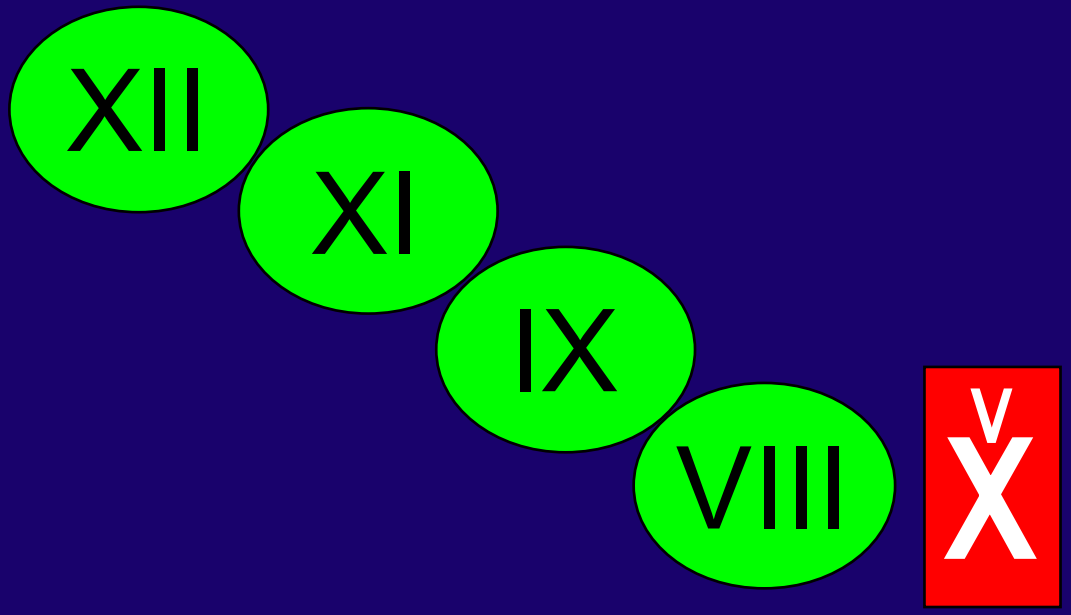


Coagulation made easy - the PT



Coagulation made easy - the aPTT

The PTT Pathway



The PTT pathway has all those hideous roman numerals. . .
How are we going to remember them?
Hmmmmm. . . . . .

Prothrombin → **Thrombin**

Fibrinogen → **Fibrin**

Coagulation made easy - the aPTT

The PTT Pathway

T E N 8

Well, just remember that the PTT is a basic TENET (TEN8) of hematology.
TENET stands for. . . . . .

V X

Prothrombin → Thrombin

Fibrinogen → Fibrin

Coagulation made easy - the aPTT

Twelve

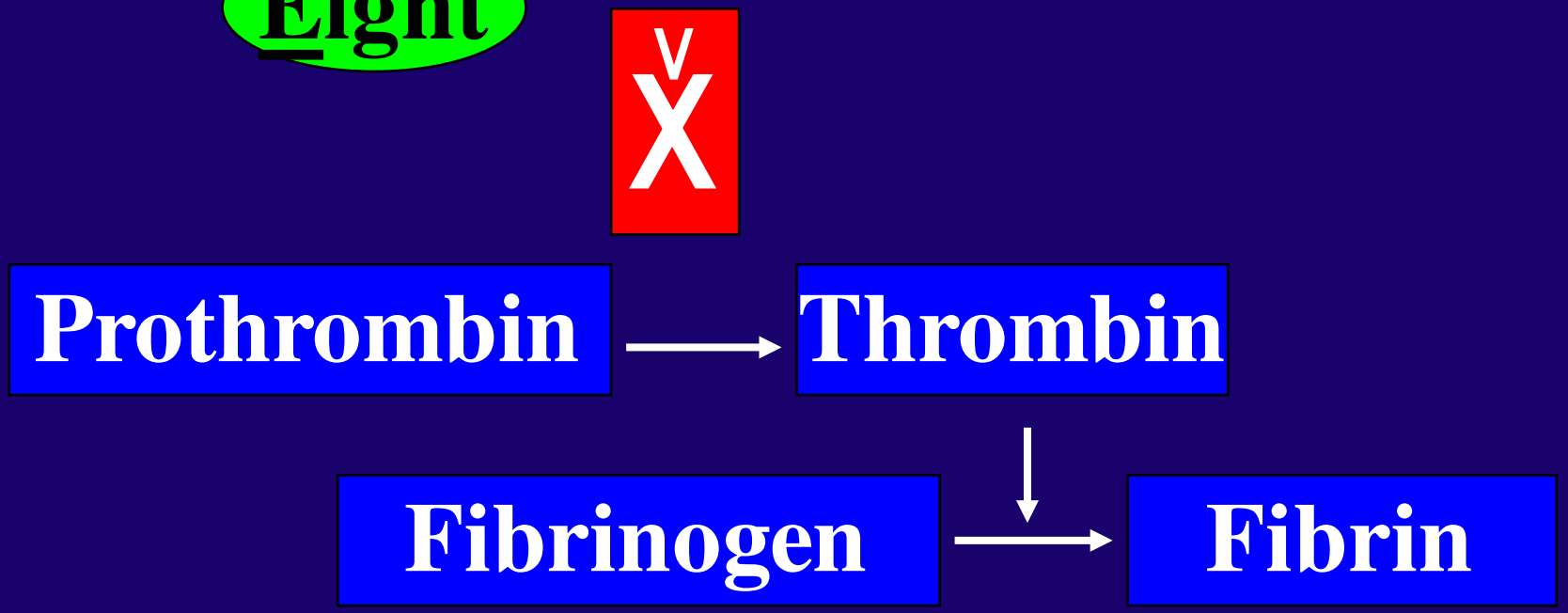
Eleven

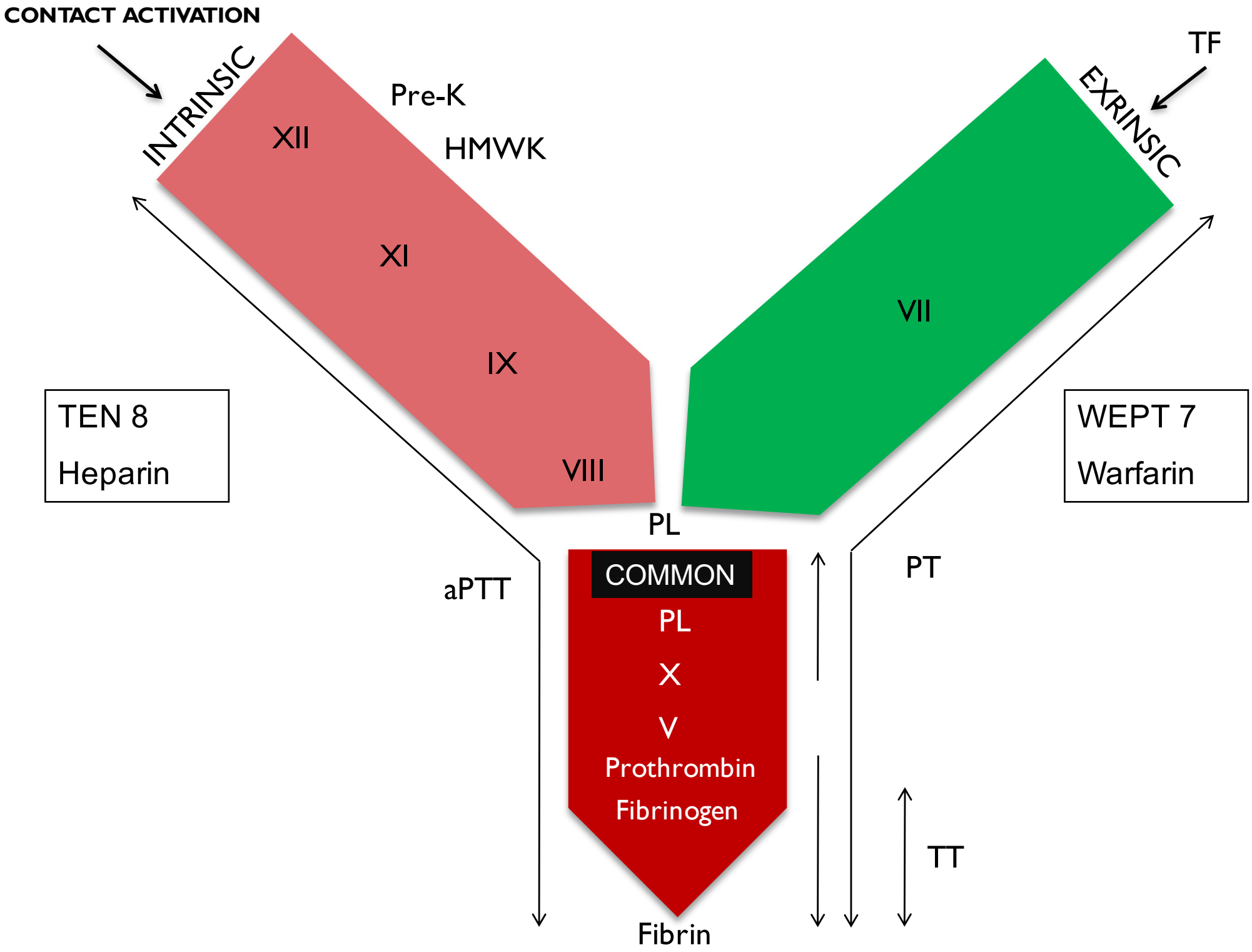
Nine

Eight

The PTT Pathway

TEN 8




CONTACT ACTIVATION
INTRINSIC
Pre-K
XII
HMWK
XI
IX
VIII
TF
EXRINSIC
VII
TEN 8
Heparin
WEPT 7
Warfarin
PL
COMMON
PL
X
V
Prothrombin
Fibrinogen
aPTT
PT
TT
Fibrin

PT

Platelet Poor Plasma Sample (Containing all Factors)

+

PT Reagent

(Tissue Factor, PL, Ca^{++})

Abnormality	Interpretation
Isolated Prolonged PT	Factor VII deficiency
Prolonged PT in association with other coagulation abnormalities	Vitamin K deficiency Vitamin K antagonists e.g. warfarin, phenindione, rodenticides Liver disease Malabsorption (leading to vitamin K deficiency) High concentrations of unfractionated heparin Direct thrombin inhibitors e.g. Lepirudin, argatroban Afibrinogenaemia and dysfibrinogenemia Dilutional coagulopathy e.g. massive blood transfusion Multiple clotting factor deficiencies e.g. FV and FVIII deficiency Abnormalities of the vitamin K cycle e.g. mutations within the *VKORC1* gene

aPTT

Platelet Poor Plasma Sample (Containing all Factors)

+

aPTT Reagent

(PL, Silica)

↓

Incubation

+

Calcium Chloride

Abnormality	Interpretation
Isolated Prolonged APTT	Deficiencies of either XII, XI, IX & VIII. Acquired clotting factor inhibitors - these are most commonly directed against FVIII. Lupus anticoagulant [LA]
Prolonged APTT + Prolonged PT	Vitamin K deficiency Liver disease Direct thrombin inhibitors including Hirudin, Argatroban and Dabigatran. DIC - due to the consumption of clotting factors Massive blood transfusion leading to a dilutional coagulopathy

1

All are components of hemostasis except-

- a) Blood Platelets
- b) Red blood cells
- b) Endothelial Cells
- c) Plasma Coagulation Factors

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2

Steps involved in hemostasis include all <u>except</u>-

- a) Vasodilatation
- b. Formation of a platelet plug
- c. Blood Coagulation
- d. Clot retraction and thrombus dissolution

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3

Which organ is primarily responsible for the formation of coagulation factors?

- a) Kidney
- b) lungs
- c) liver
- d) Brain

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4

Which test evaluates the extrinsic pathway?

a). PT

b). PTT

c). TT

d). Closure time

e). Bleeding time

Which test evaluates the extrinsic pathway?

a). PT WEPT 7

b). PTT

c). TT

d). Closure time

e). Bleeding time

Heparin is monitored by the following test-

a). PT

b). PTT

c). TT

d). Closure time

e). Bleeding time

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a). PT

b). PTT

c). TT

d). Closure time

e). Bleeding time

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Which of the following these patients may have a normal PTT?

- a) Thrombocytopenia
- b) Hemophilia A
- c) Hemophilia B
- d) Patient on heparin

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- c) Hemophilia B
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Prolongation of Bleeding time seen in the following disorders <u>except-</u>

- a) Thrombasthenia
- b) Thrombocytopenia
- c) Von Willebrand ds.
- d) Hemophilia

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Platelet poor plasma means platelet count less than---

- a) 50,000/cmm
- b) 10,000/cmm
- c) 1,00,000/cmm
- d) 15,000/cmm

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2/Female child – Easy Bruising

	Test Patient	Reference Range
PT	13s	11-14s
APTT	105s	23-35s
Fibrinogen(Clauss)	2.7g/L	1.5-4.0g/L
Thrombin Time	13s	10-13s

What Next

- Repeat Assay
- Mixing studies: The prolonged APTT corrects in a mix with normal plasma
- What factor assays would you request and why?

FVIII, IX , XI assays.

The FIX assay was normal but the FVIII assay was <5 IU/dl.

32/F Routine Well Woman Screening

	TestPatient	Reference Range
• PT	14s	11-14s
• APTT	**>120s**	23-35s
• Fibrinogen (Clauss)	3.2g/L	1.5-4.0g/L
• Thrombin Time	13s	10-13s

What Next

- **You repeat the tests and confirm the abnormality.**

- **How you would investigate the clotting abnormalities?**

  Mixing studies: The prolonged APTT corrects in a mix with normal plasma

- **What factor assays would you request and why?**

  Factor XII assay

  Factor XII assay was low

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