Thromboelastography (TEG) & Its Role in Determining a Patient's Coagulation Status

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Pharmacist Learning Objectives

At the end of this session, participants should be able to:

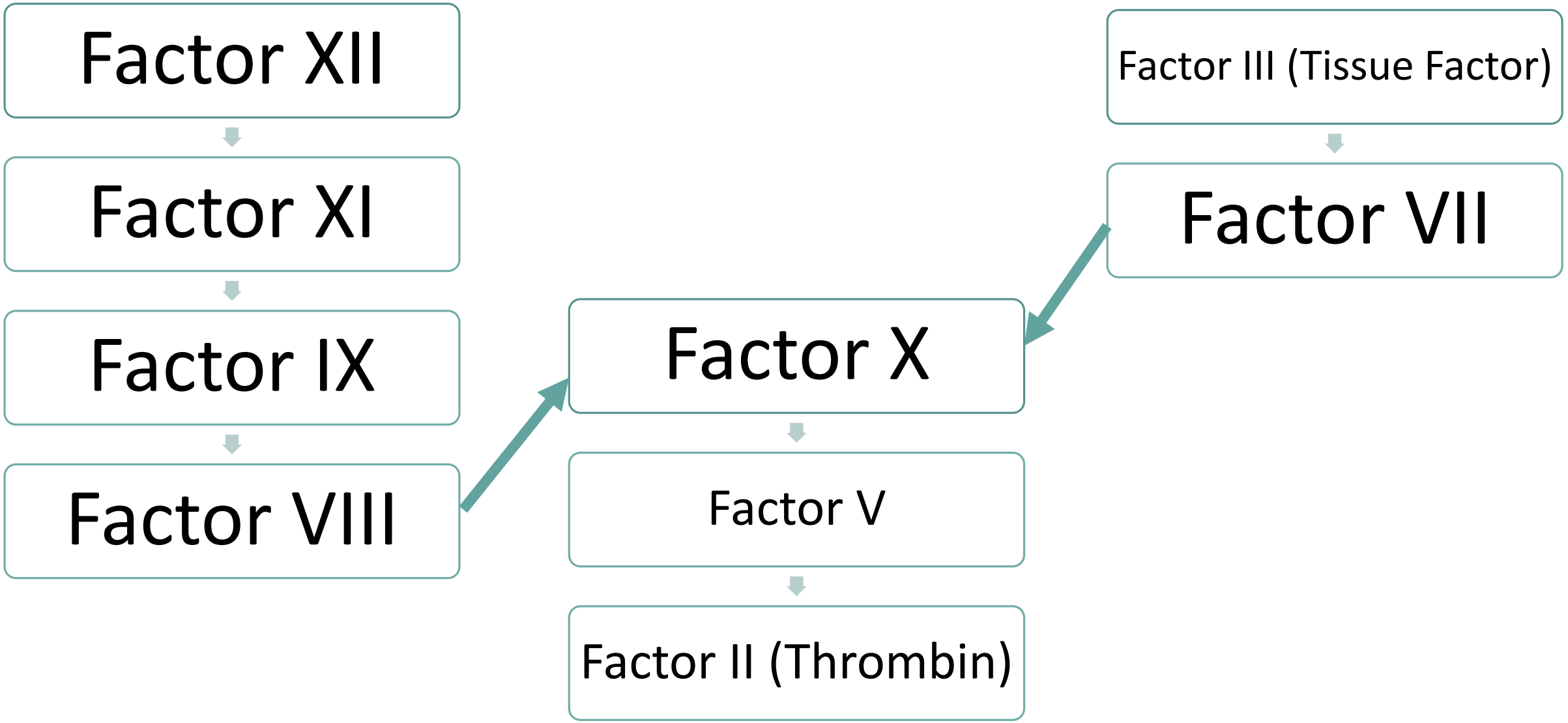
1. **Explain how TEG can be used to determine the coagulation status of a patient**

2. **Identify key measurements of a TEG and apply it to a TEG analysis**

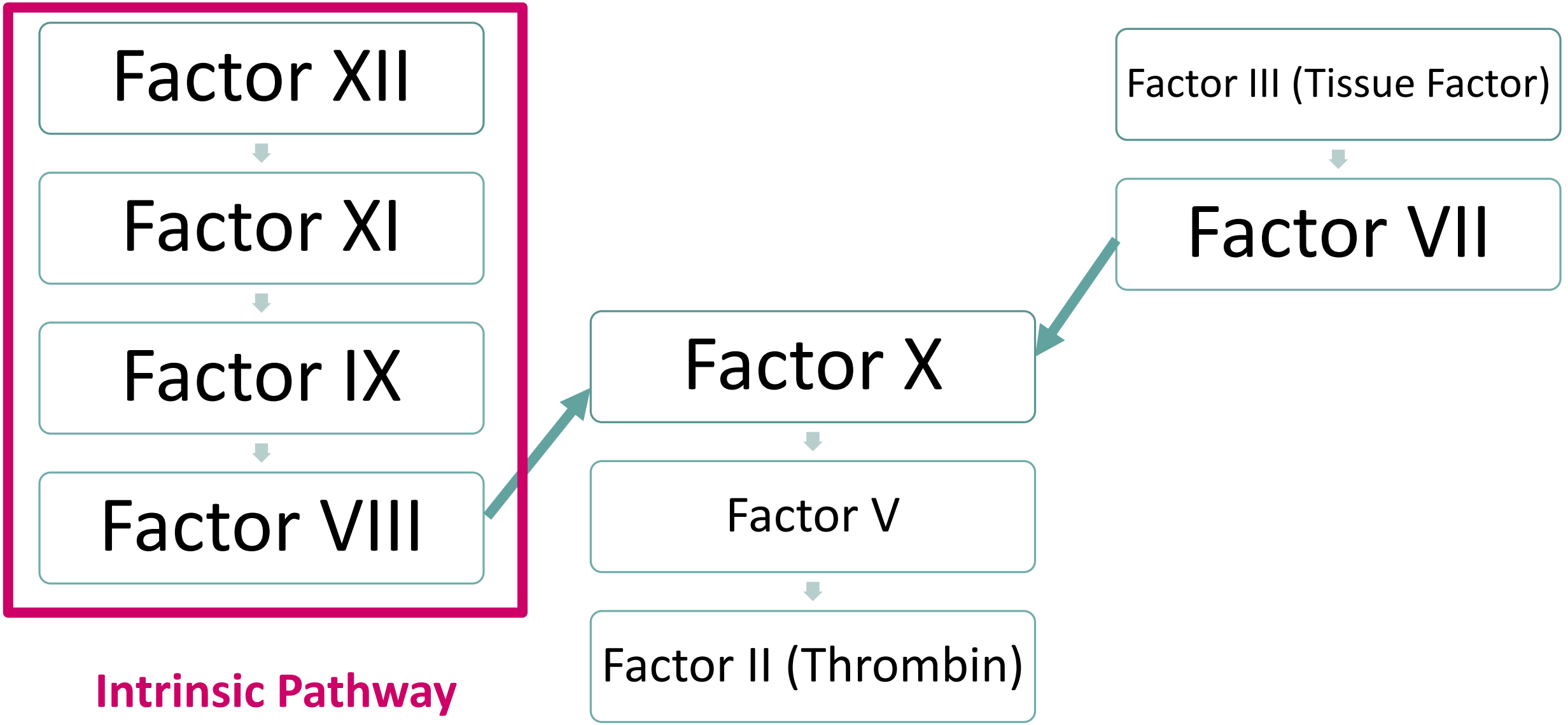
3. **Interpret a TEG analysis in order to determine the therapeutic interventions appropriate the patient's coagulation status**

Coagulation Cascade

A BRIEF OVERVIEW

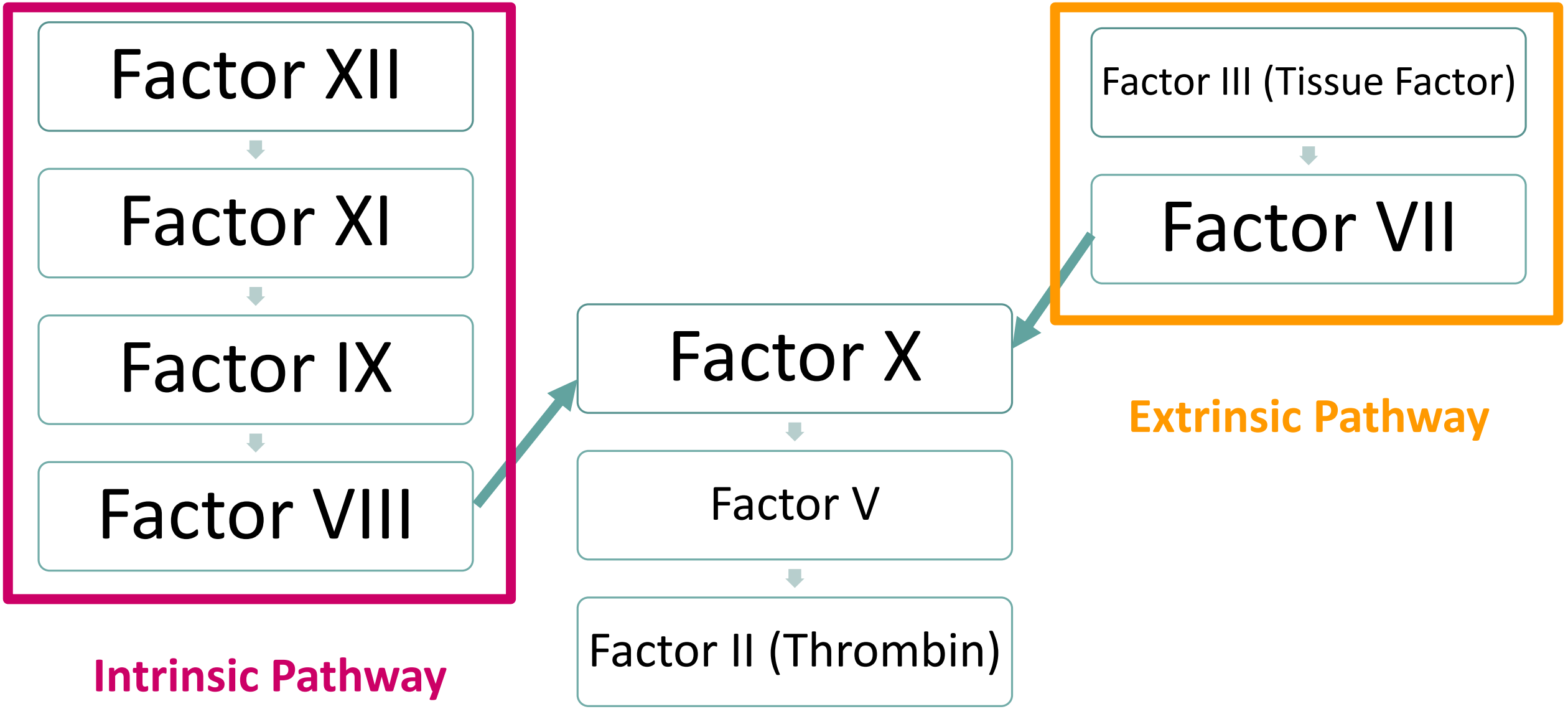


Source: Jameson JL, et al. Harrison's Principles of Internal Medicine. 2018



Intrinsic Pathway

Source: Jameson JL, et al. Harrison's Principles of Internal Medicine. 2018



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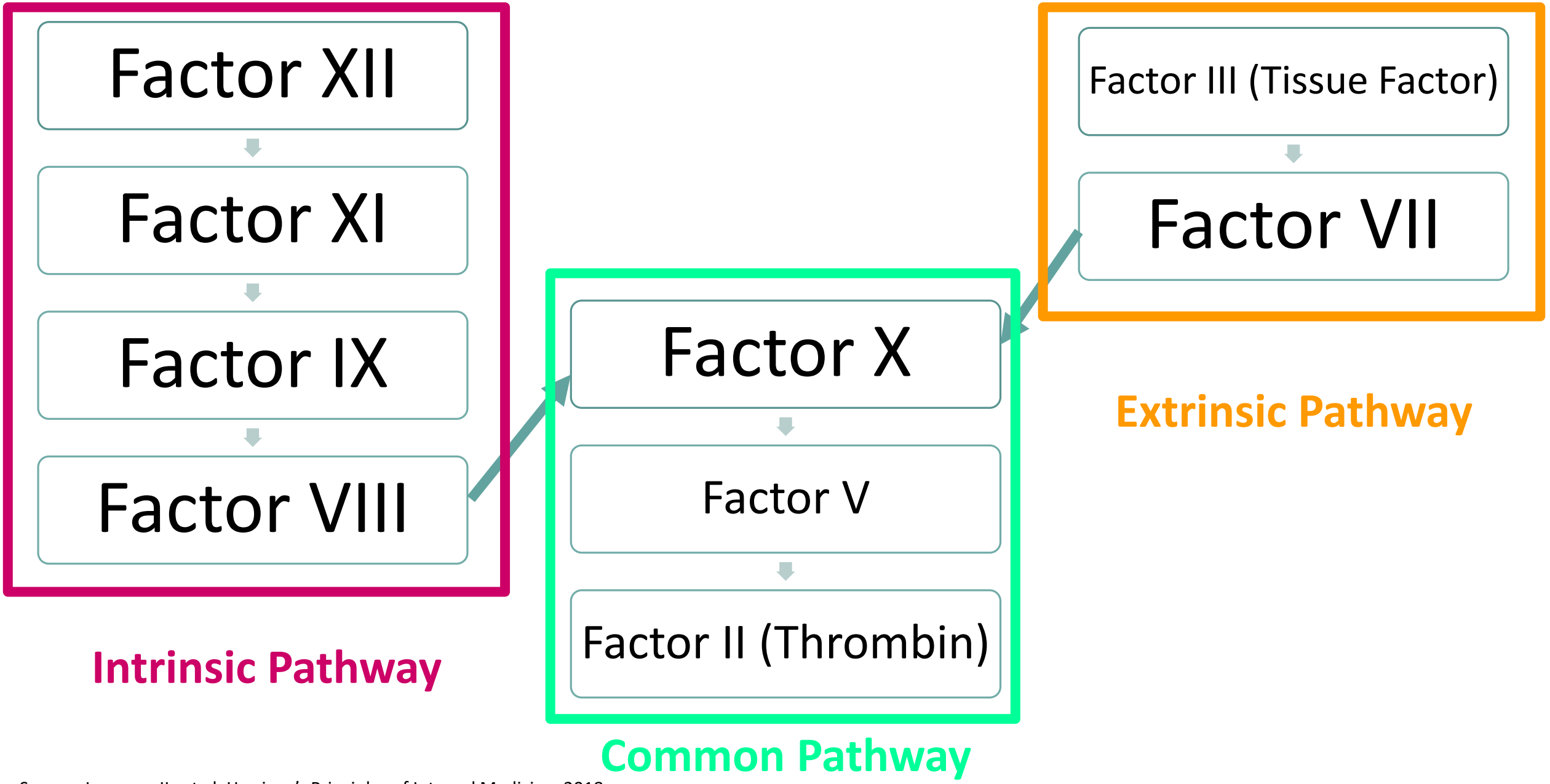

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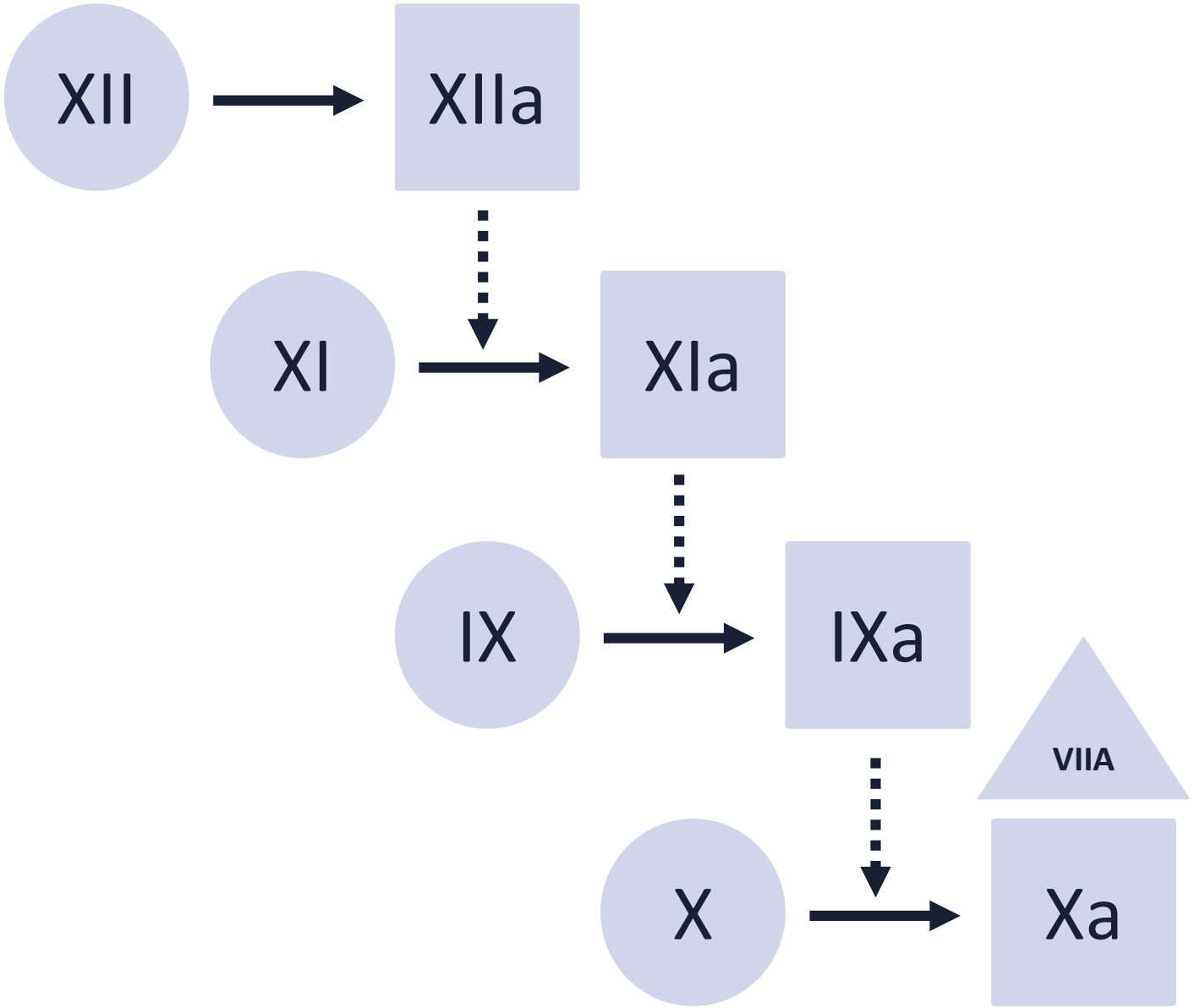

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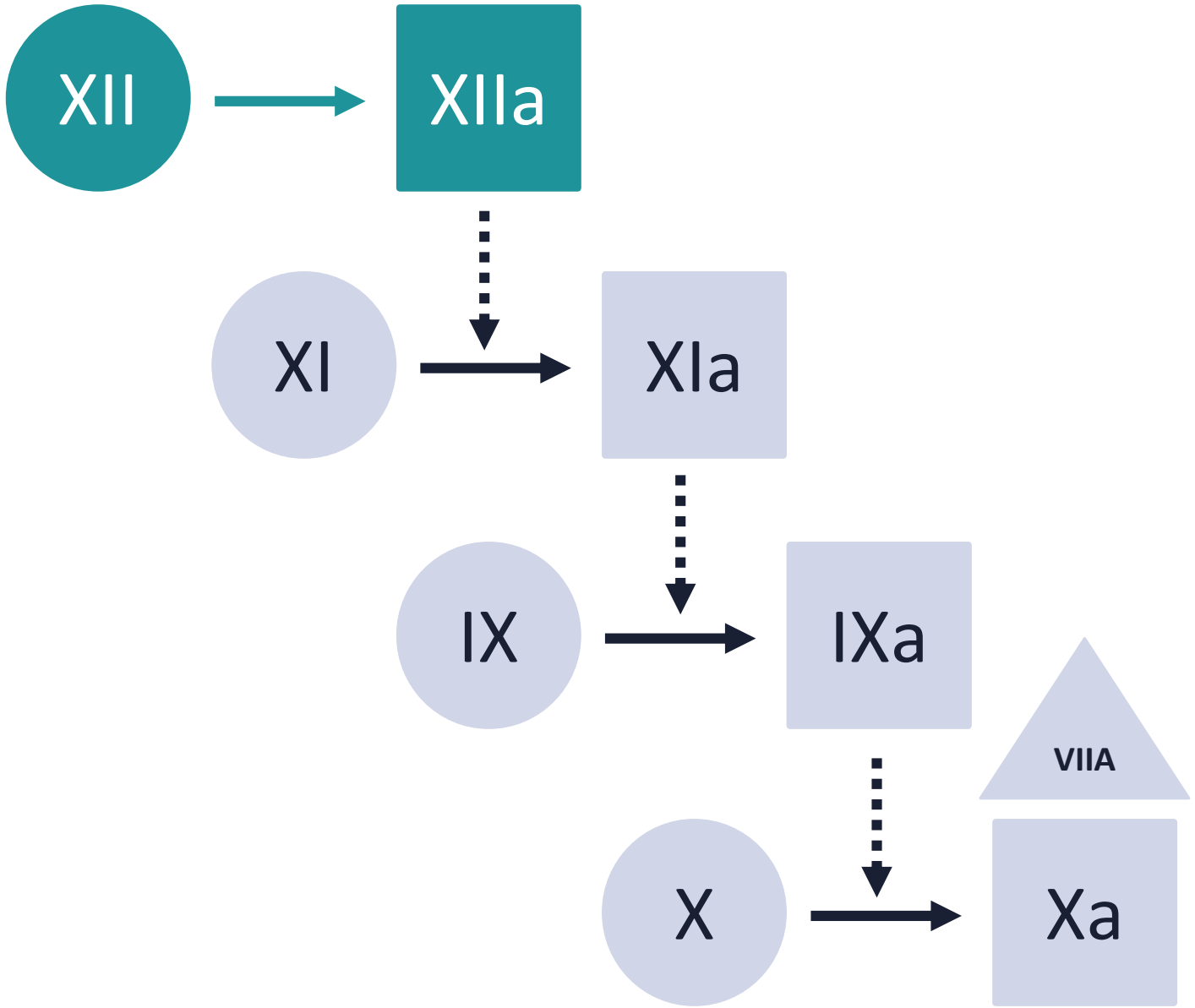

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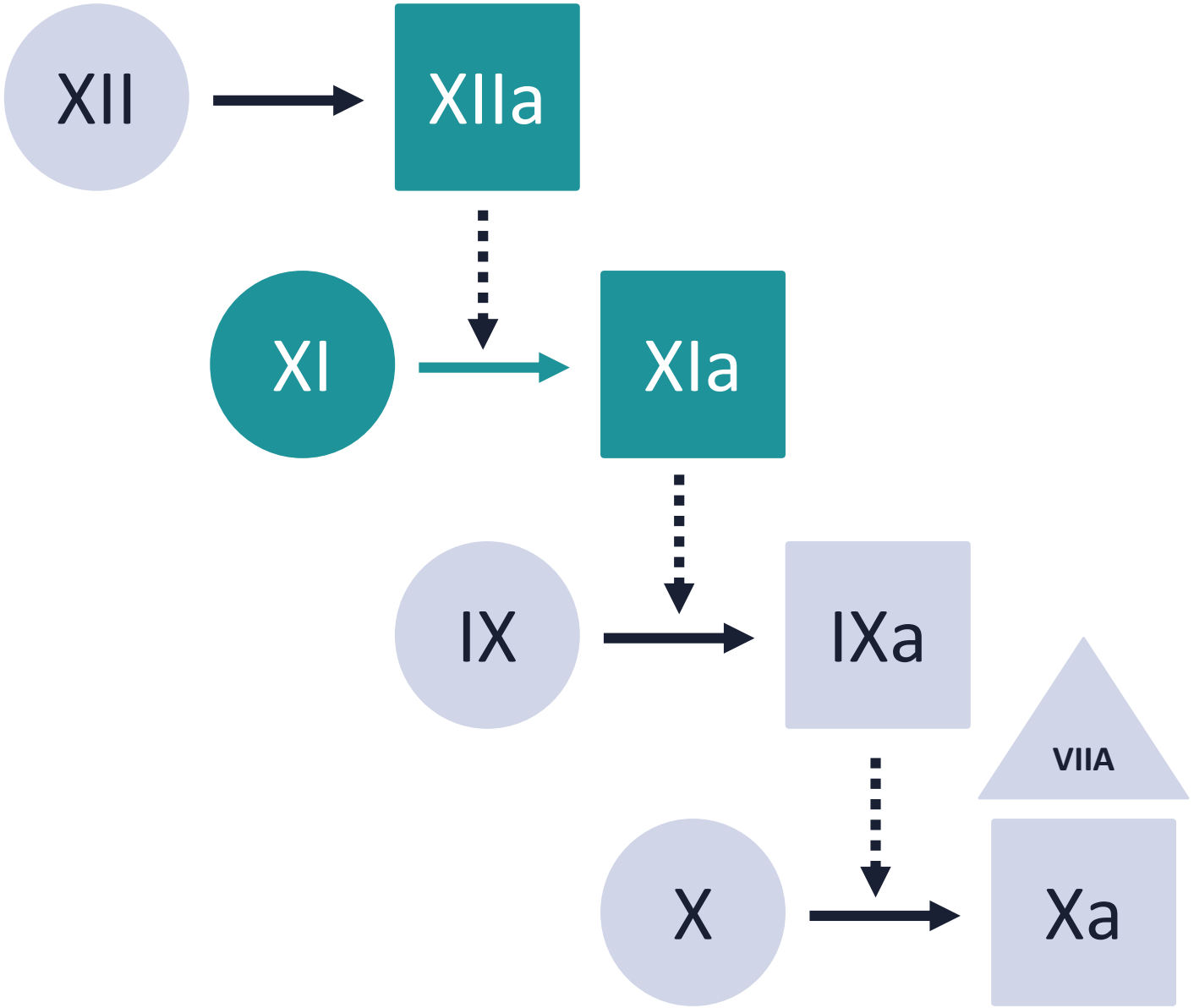

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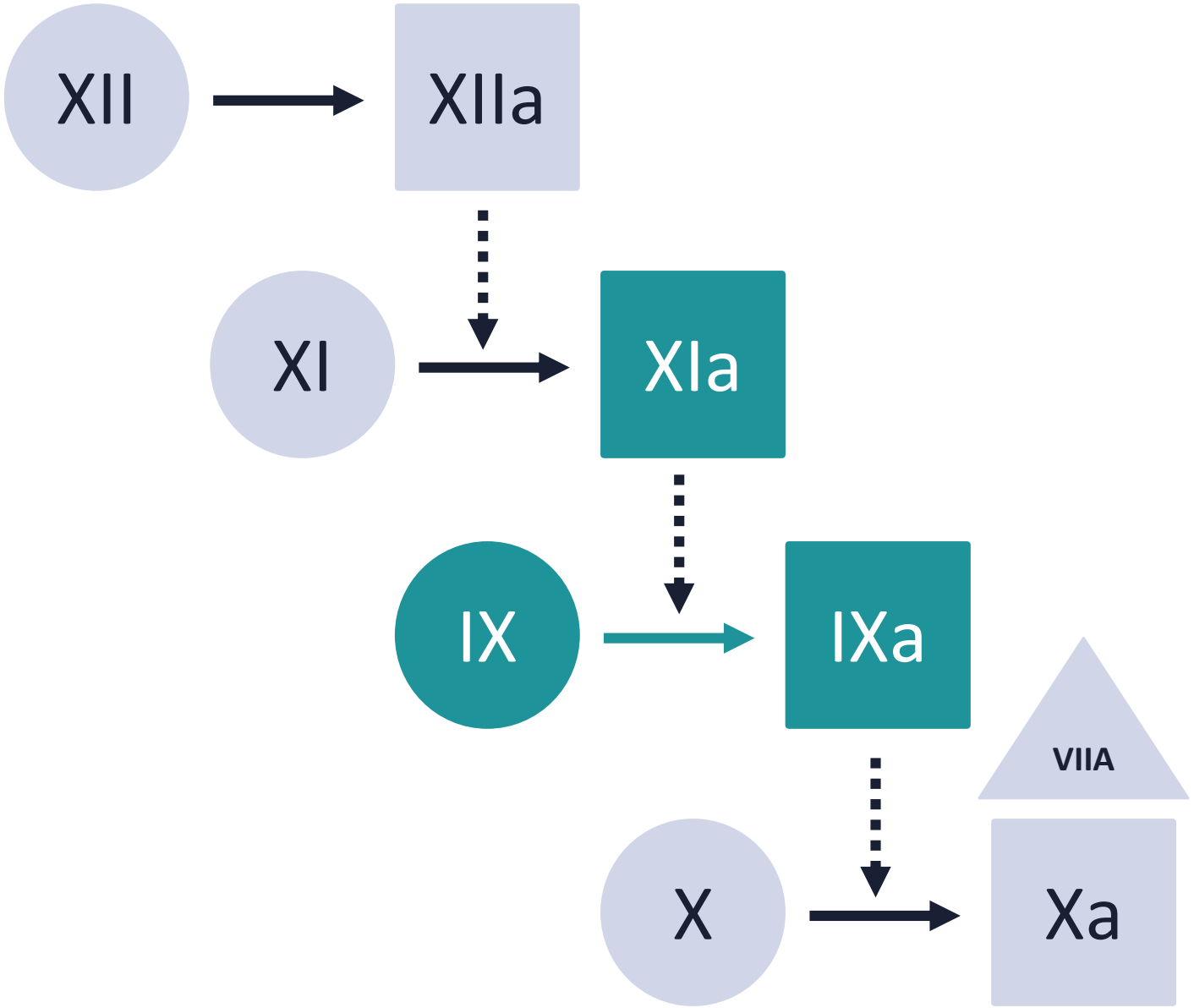

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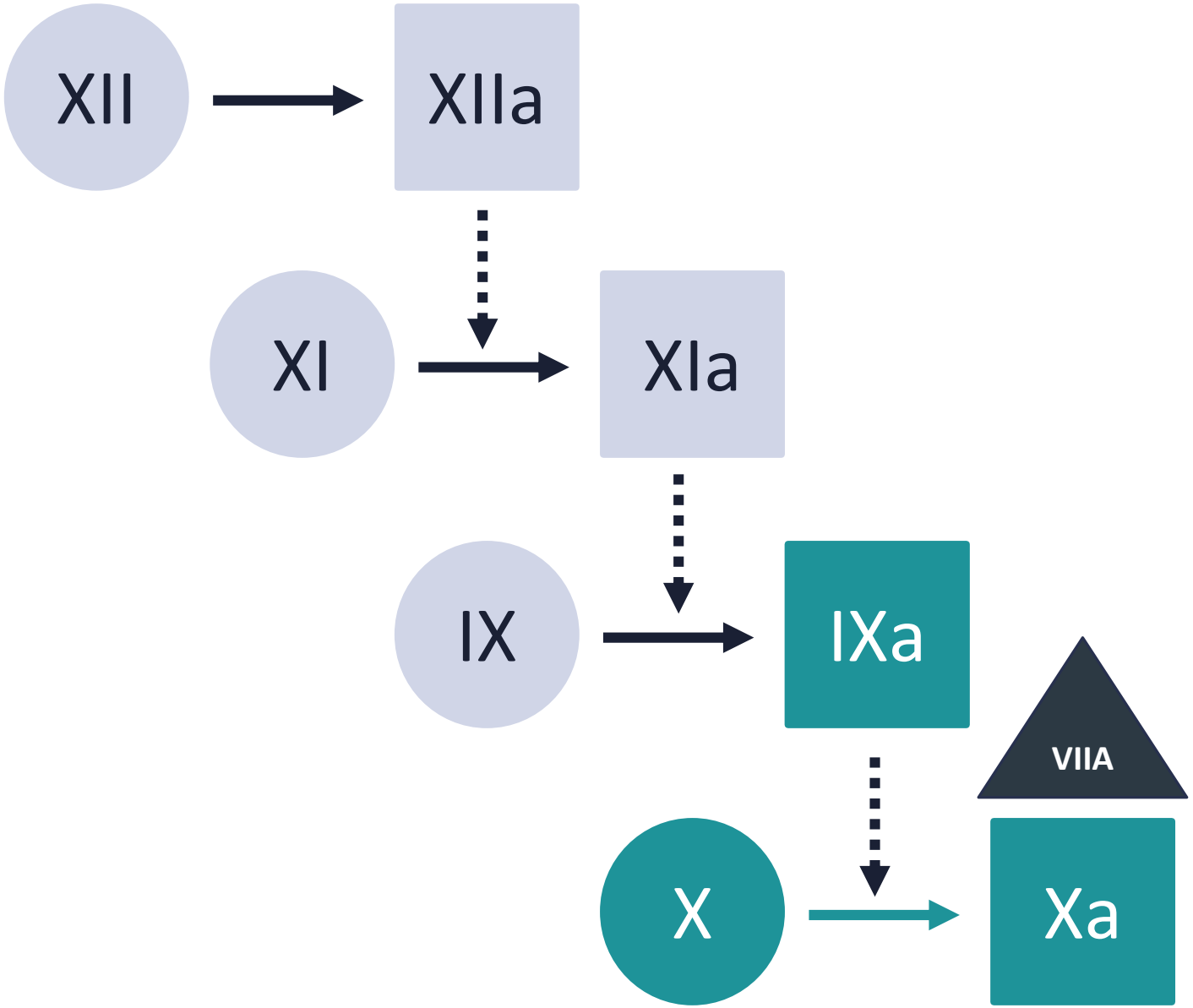

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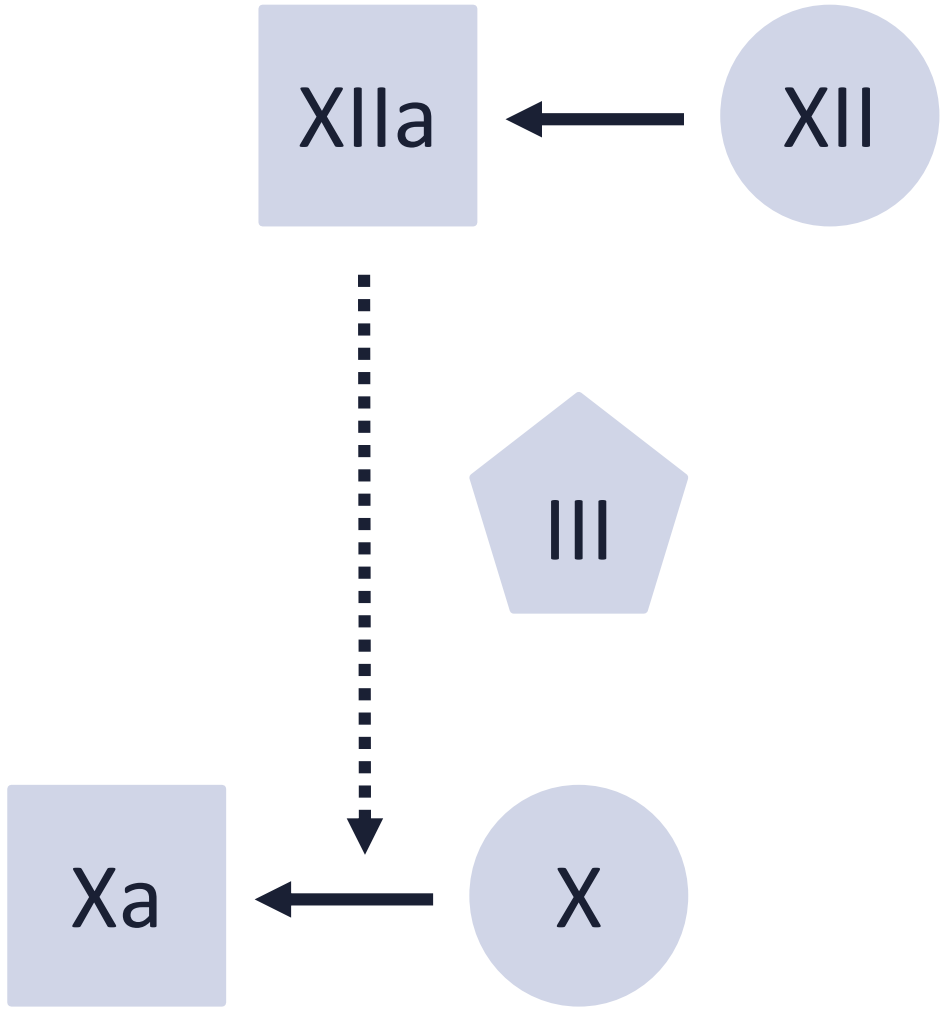

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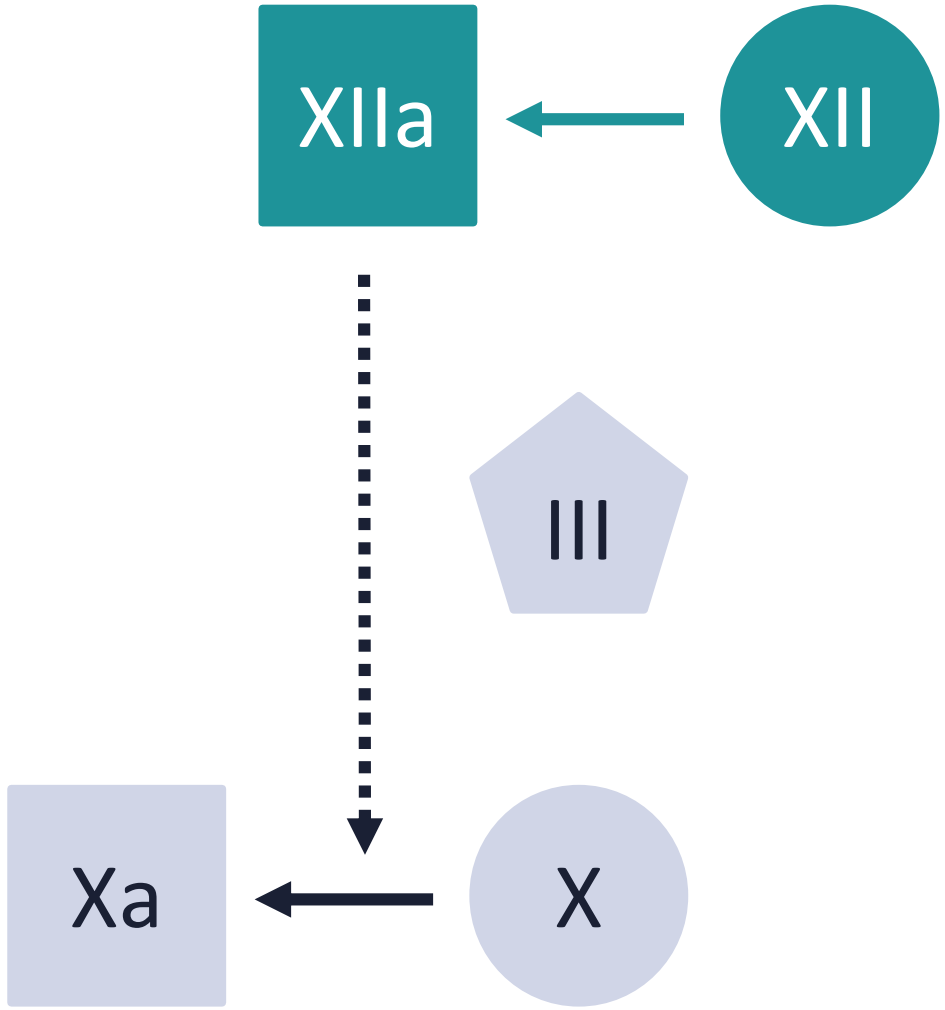

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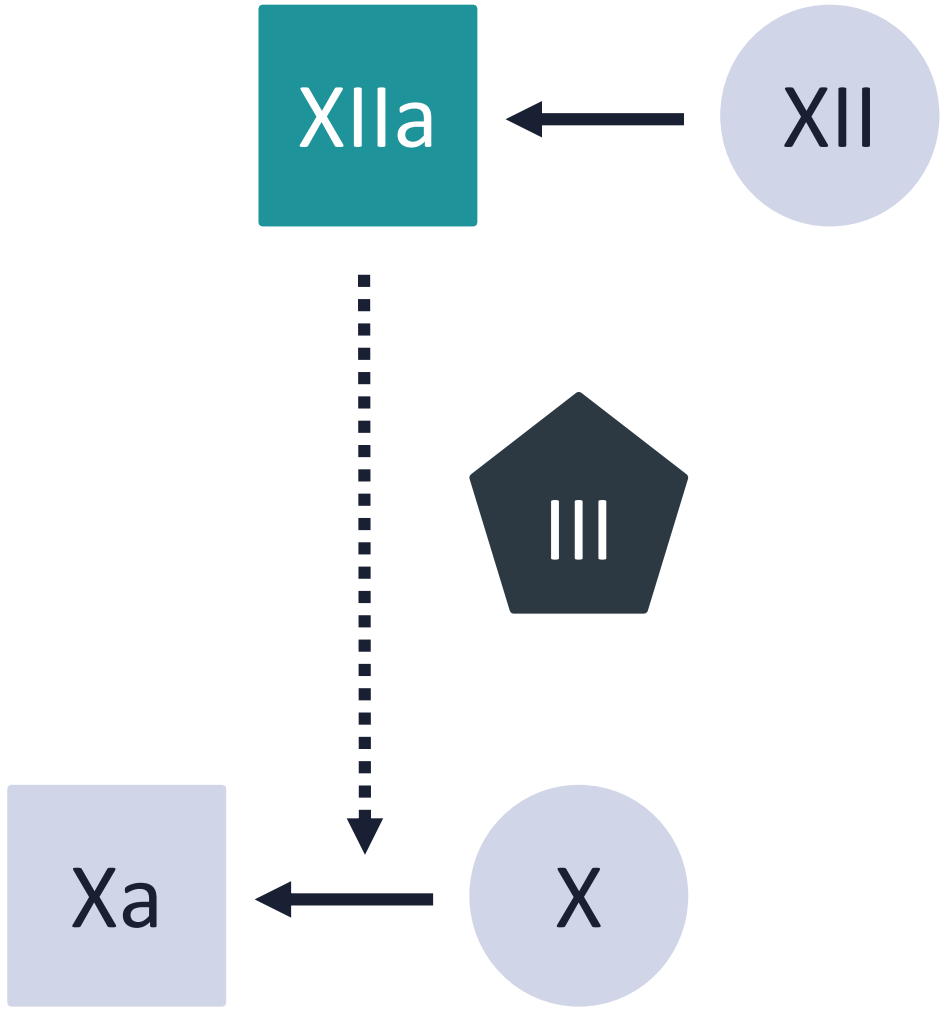

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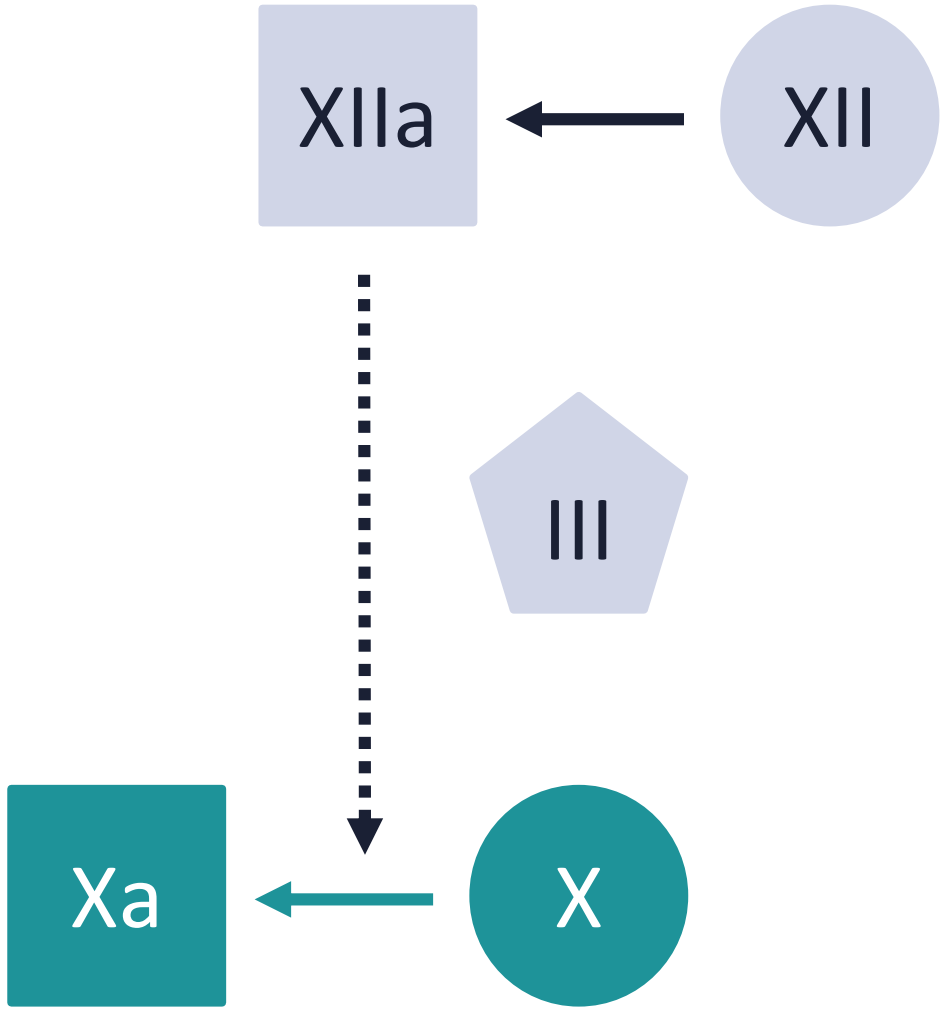

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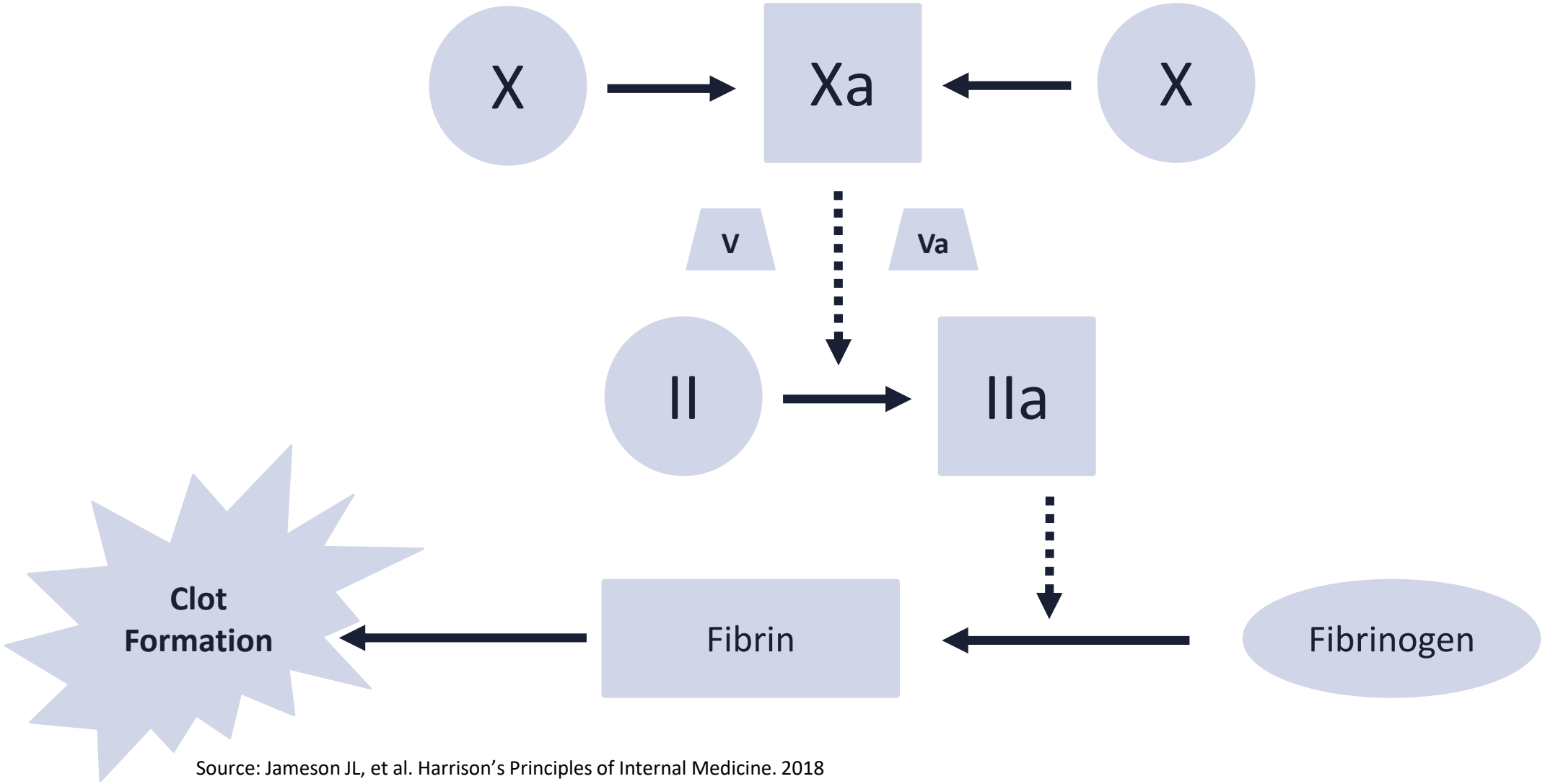
Common Pathway



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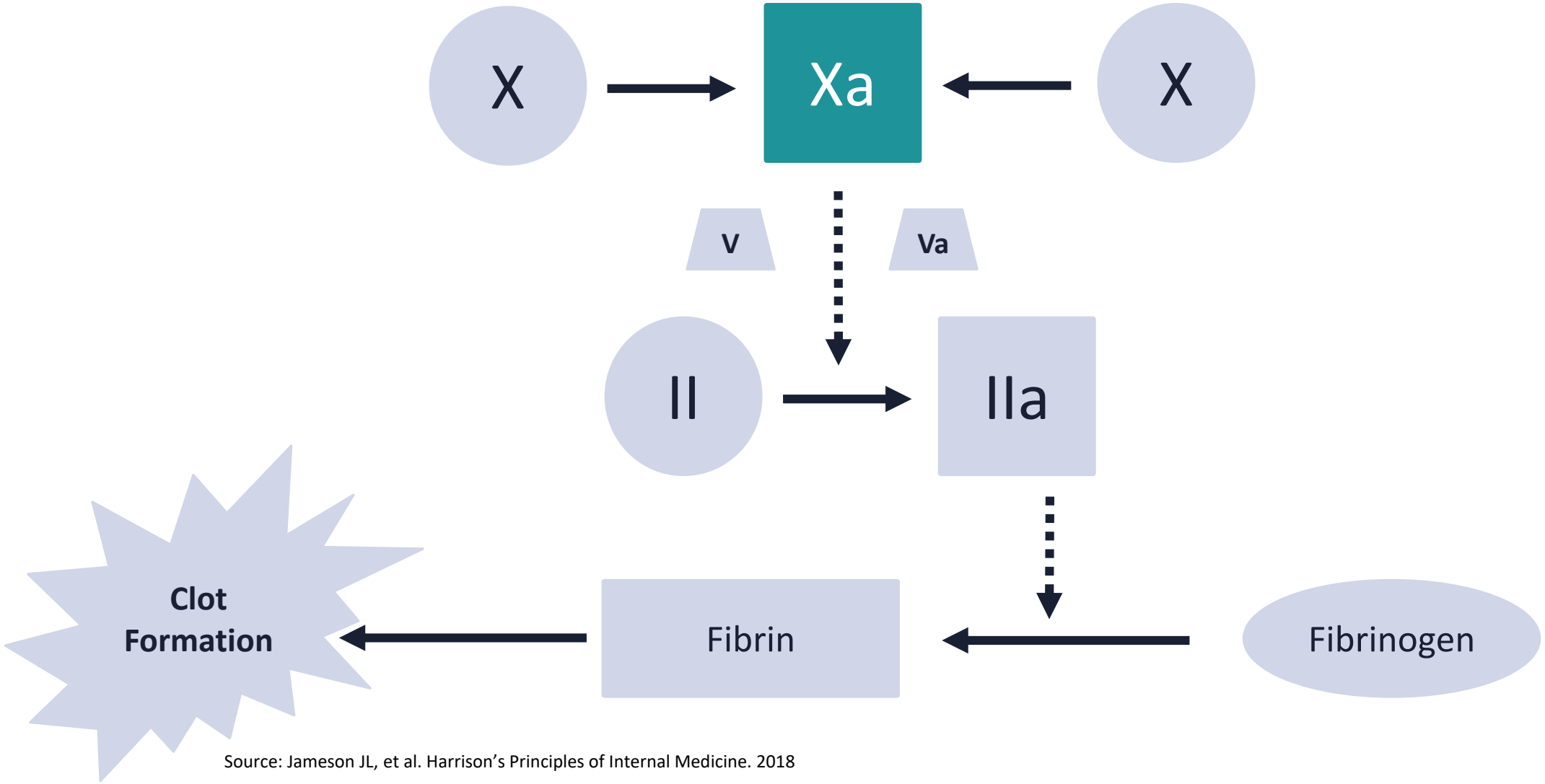

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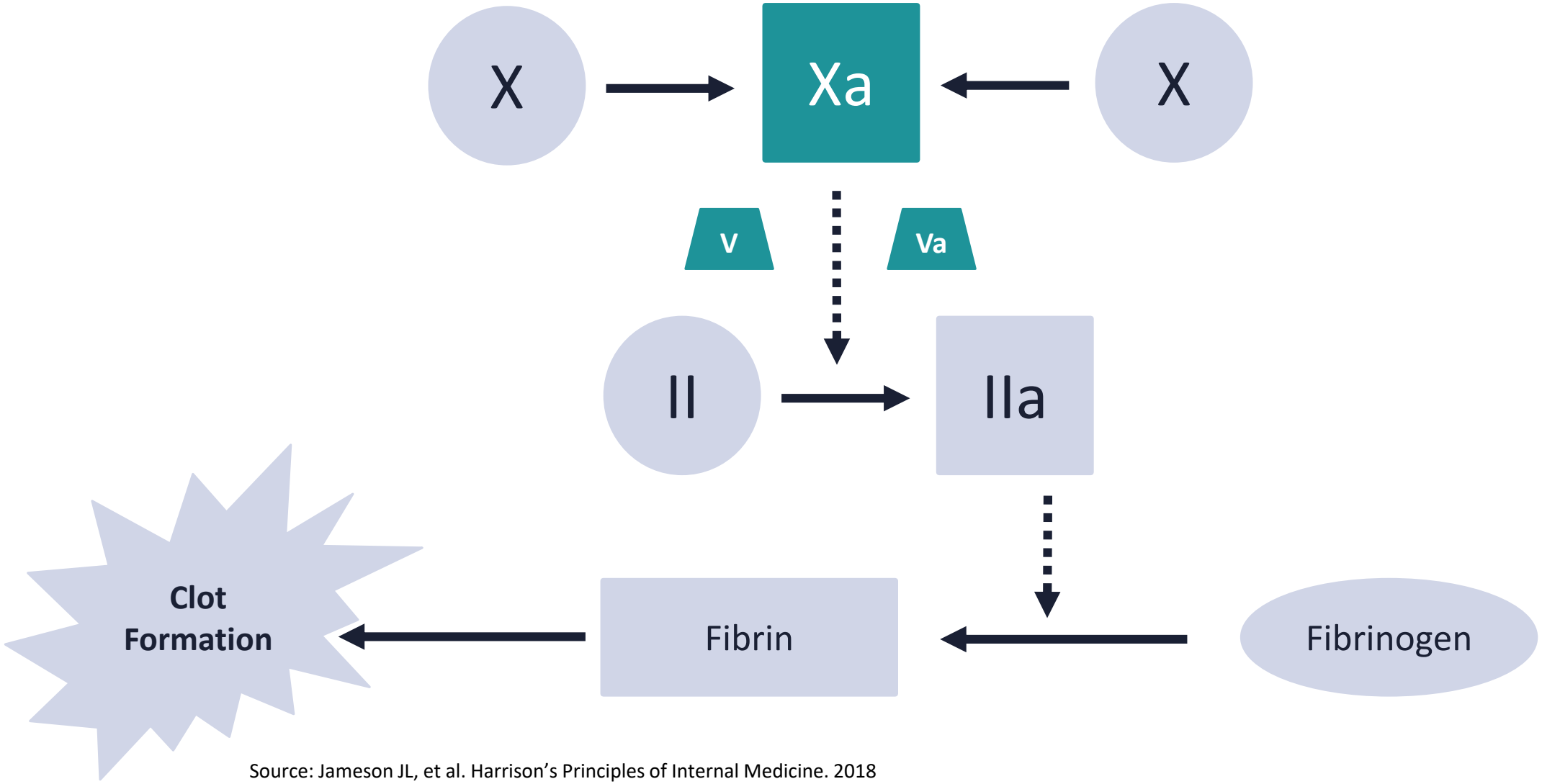

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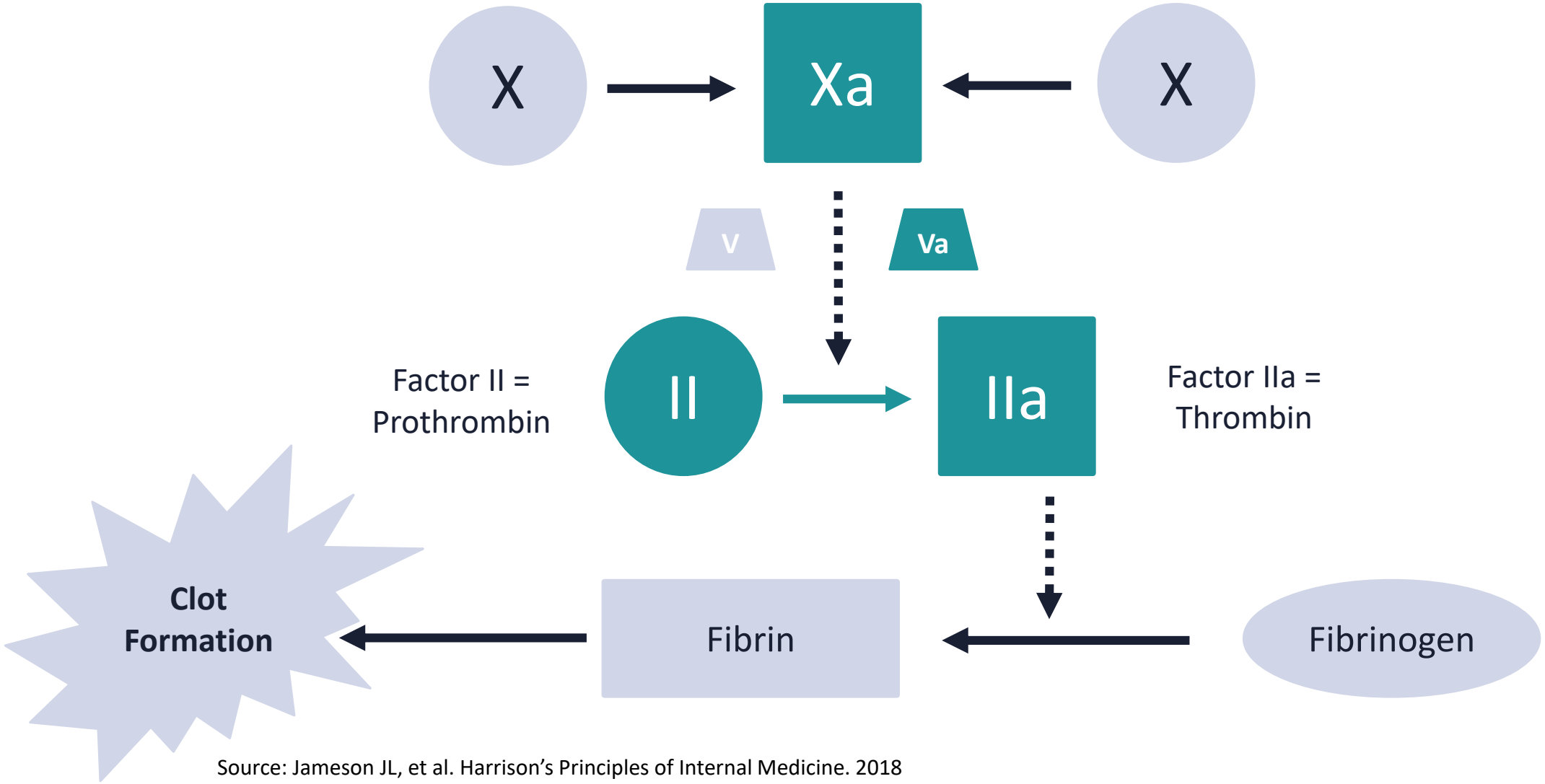

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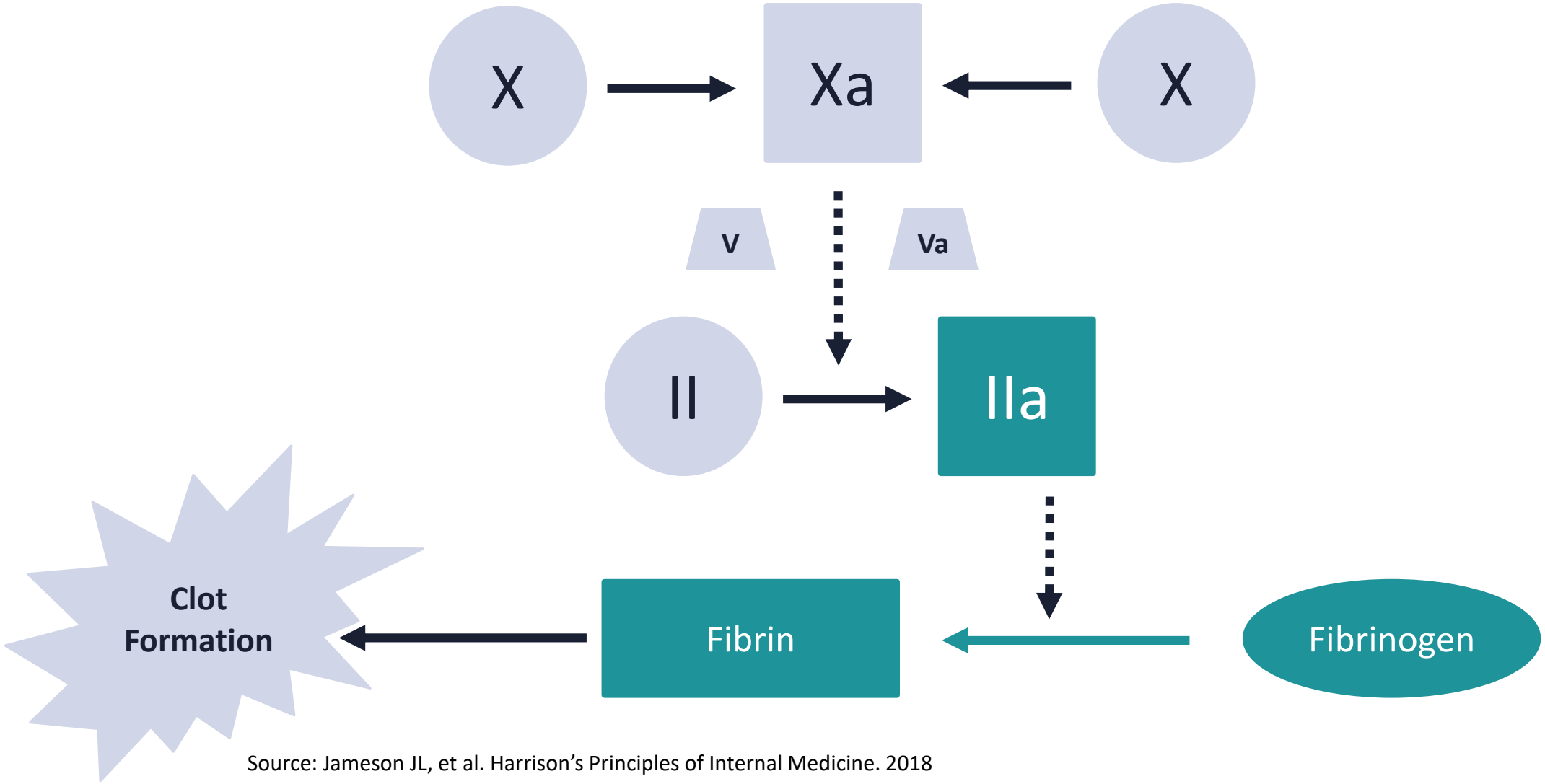

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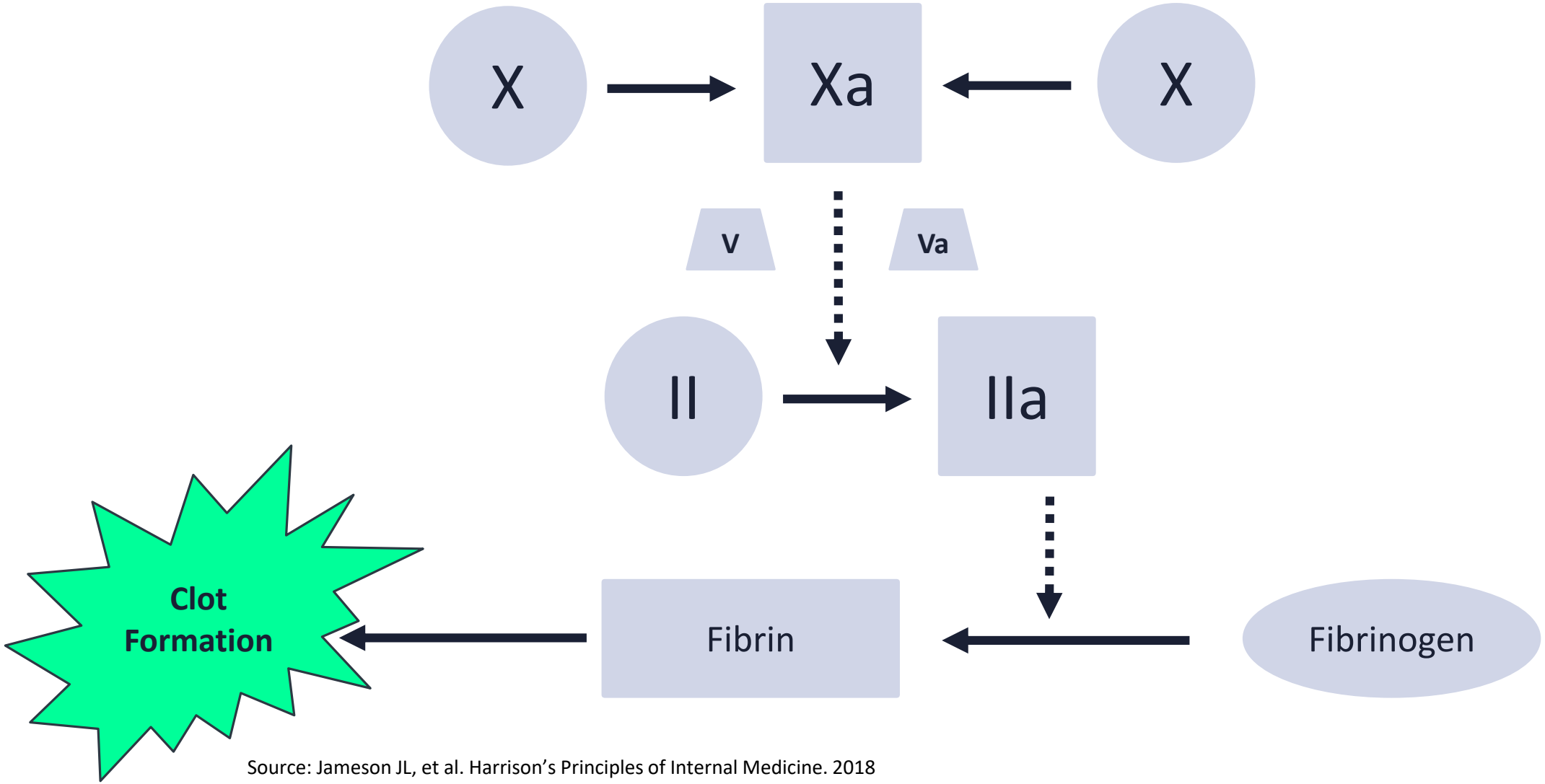

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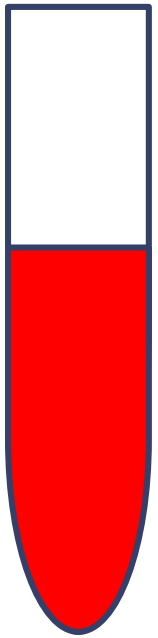
Thromboelastography (TEG)

AN INTRODUCTION

What is TEG?

How Does It Work?



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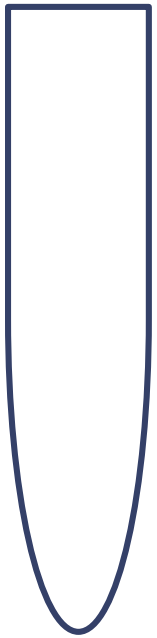

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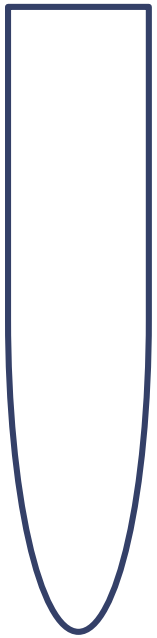

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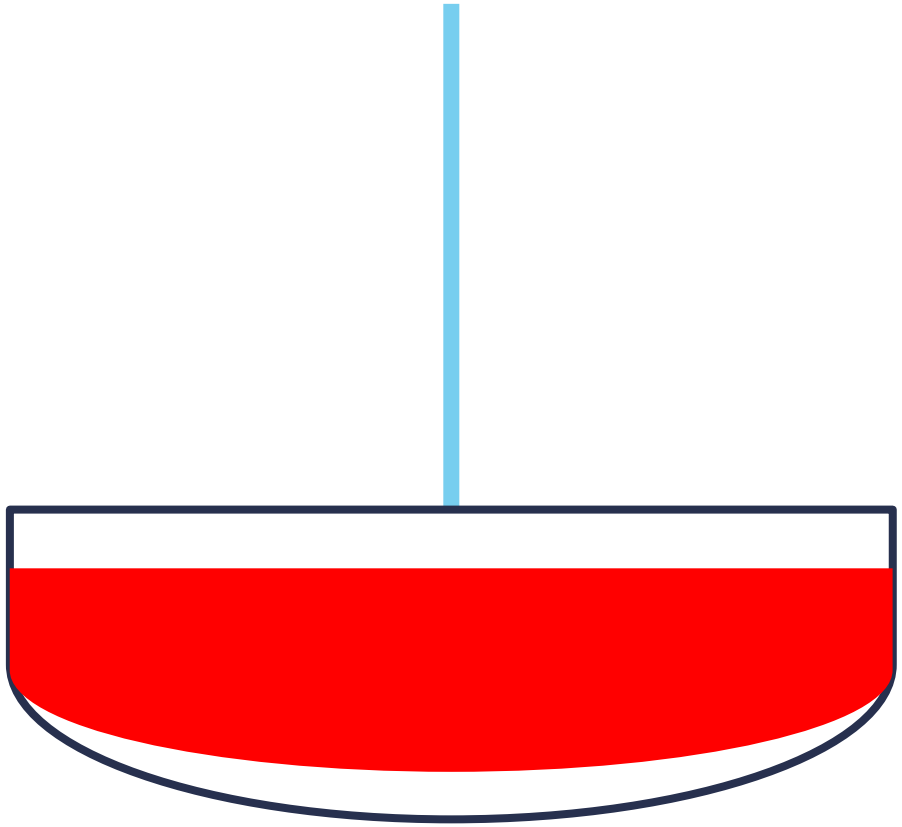

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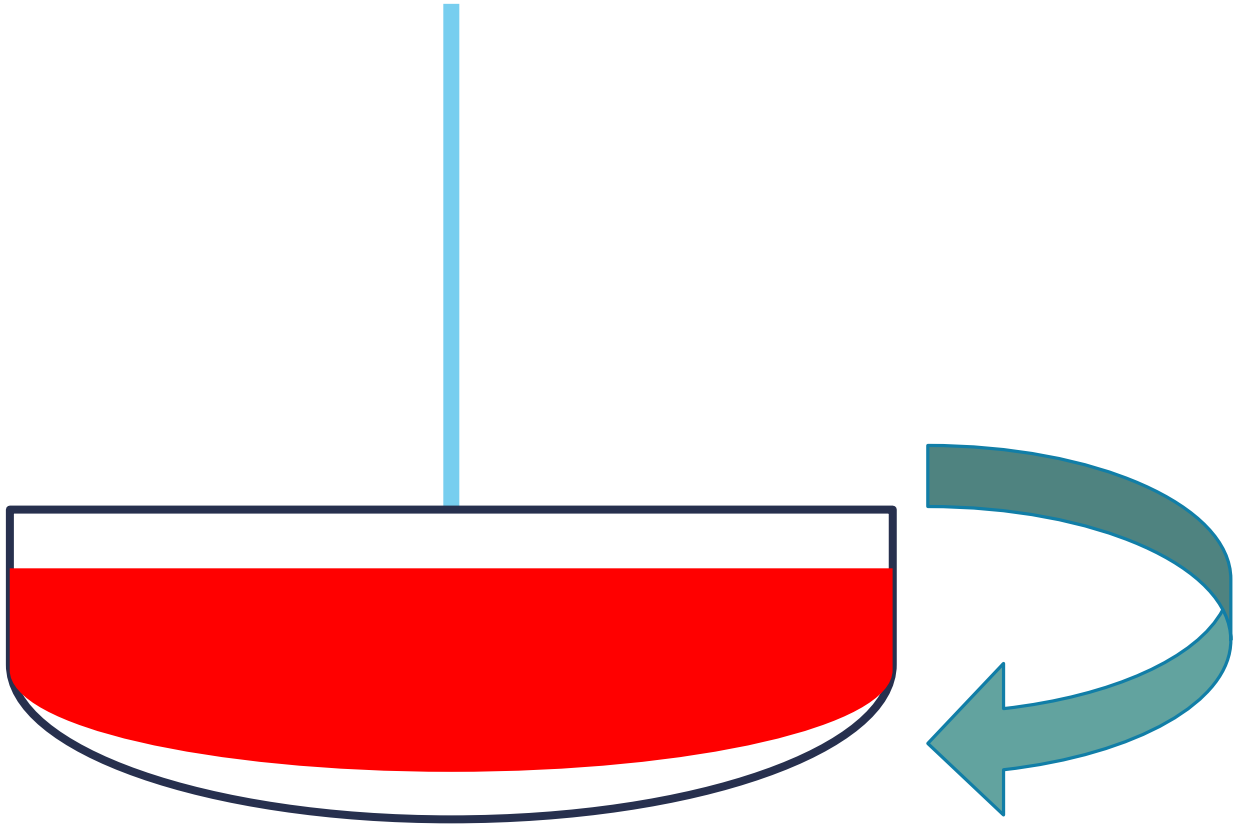

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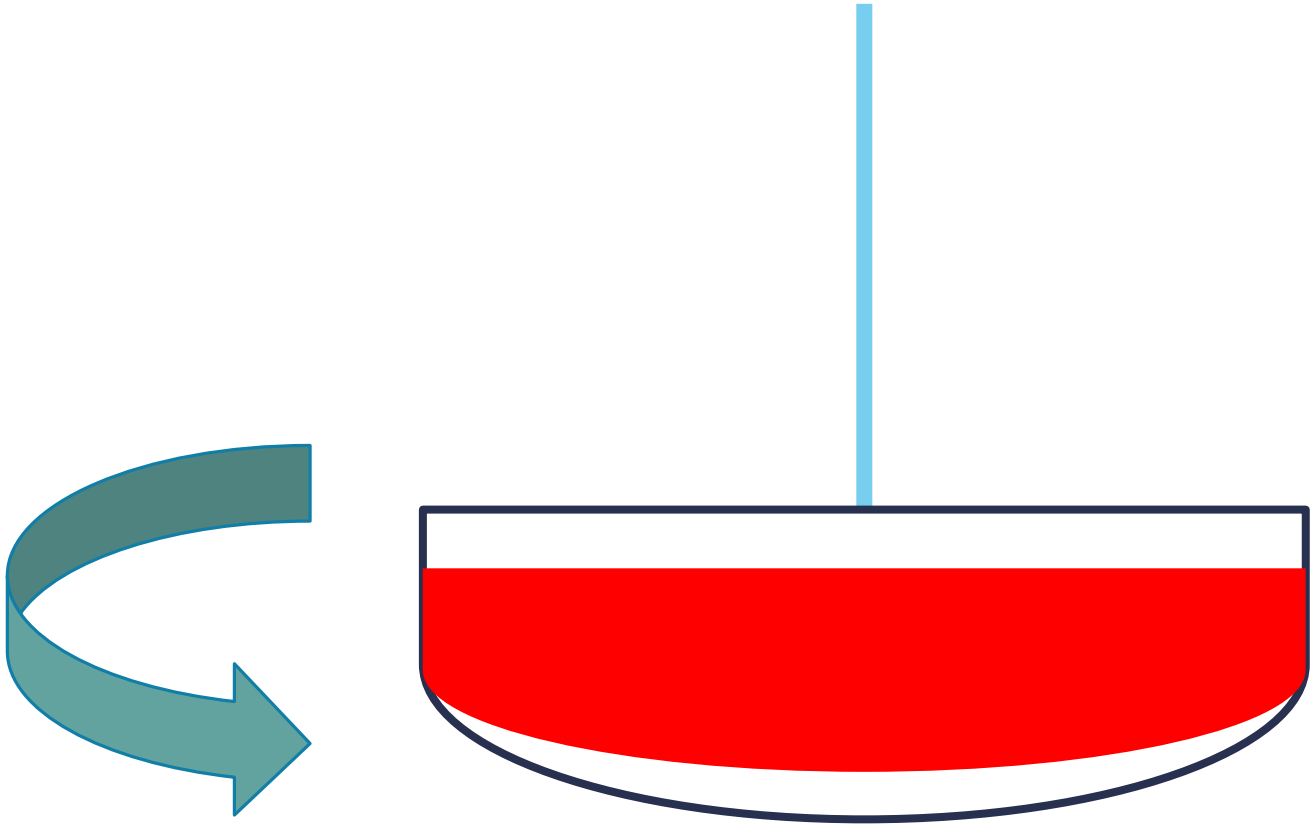

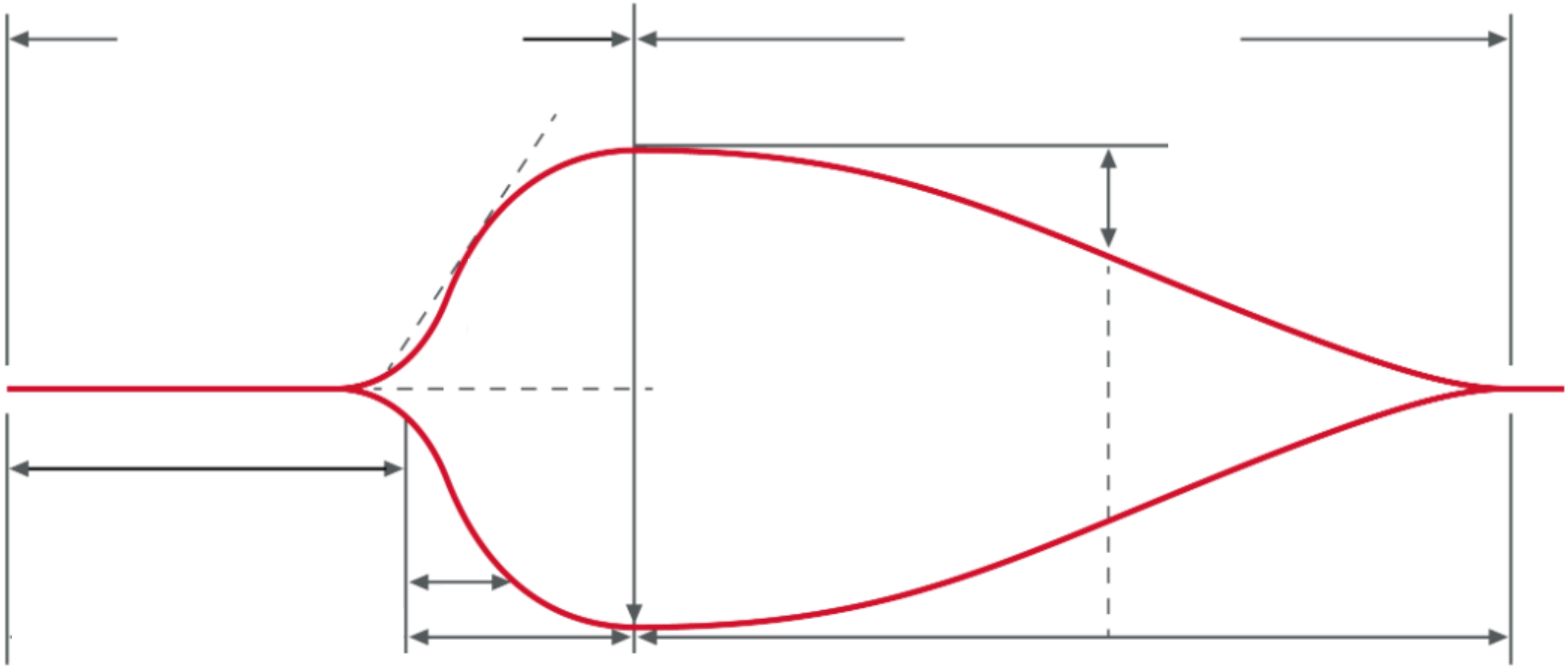

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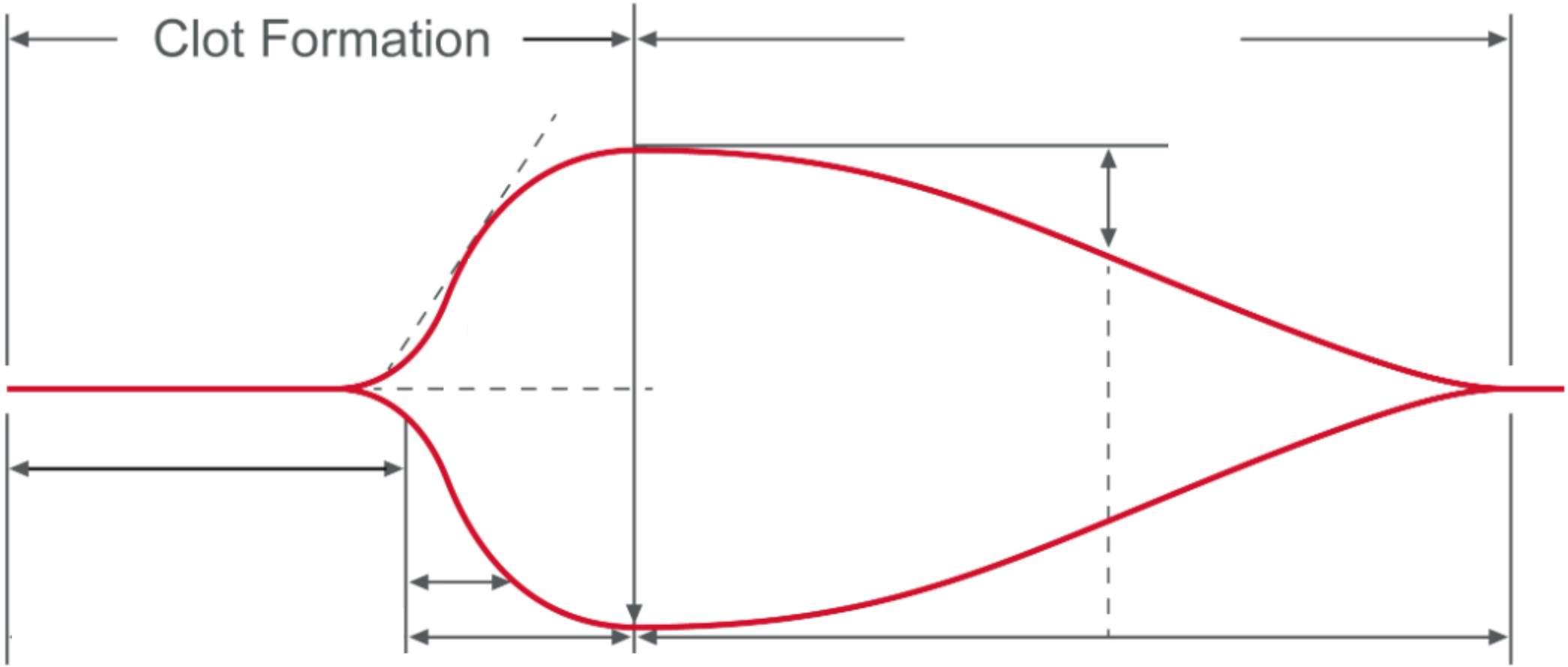

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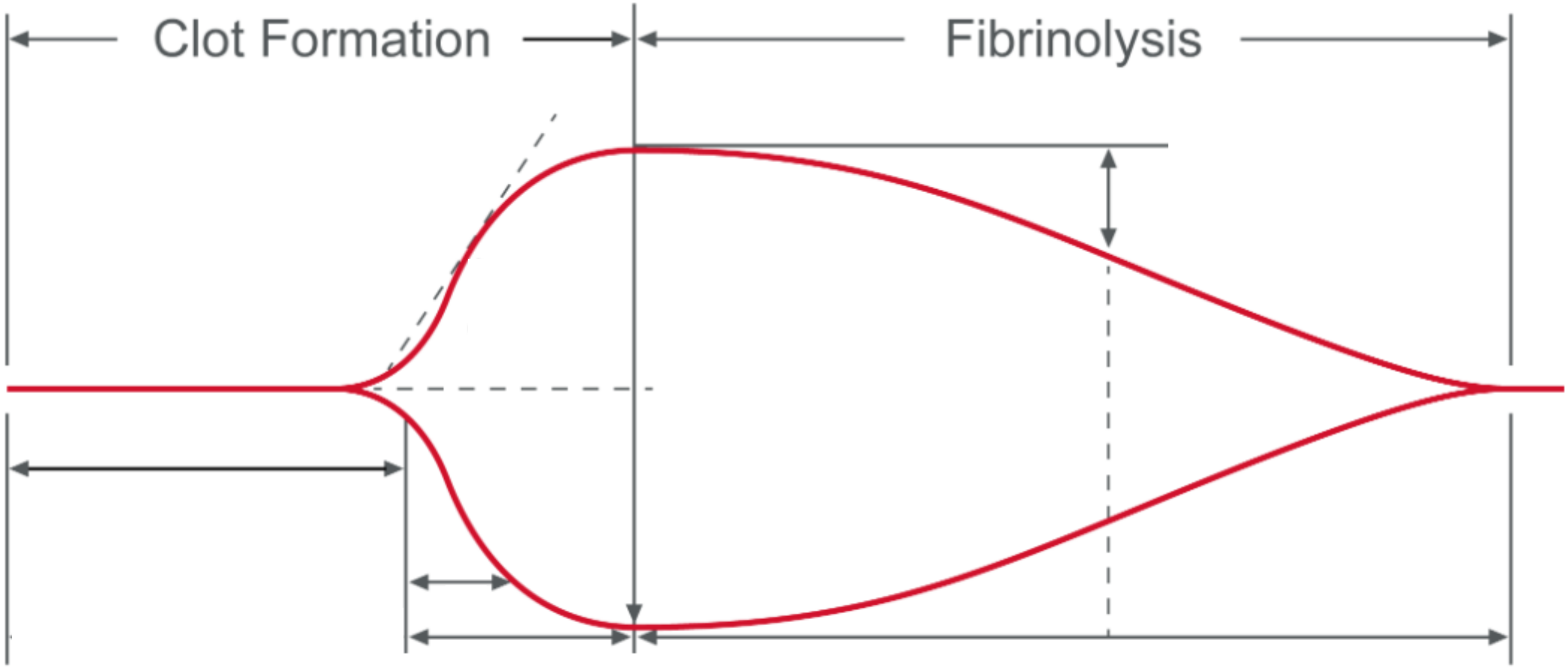

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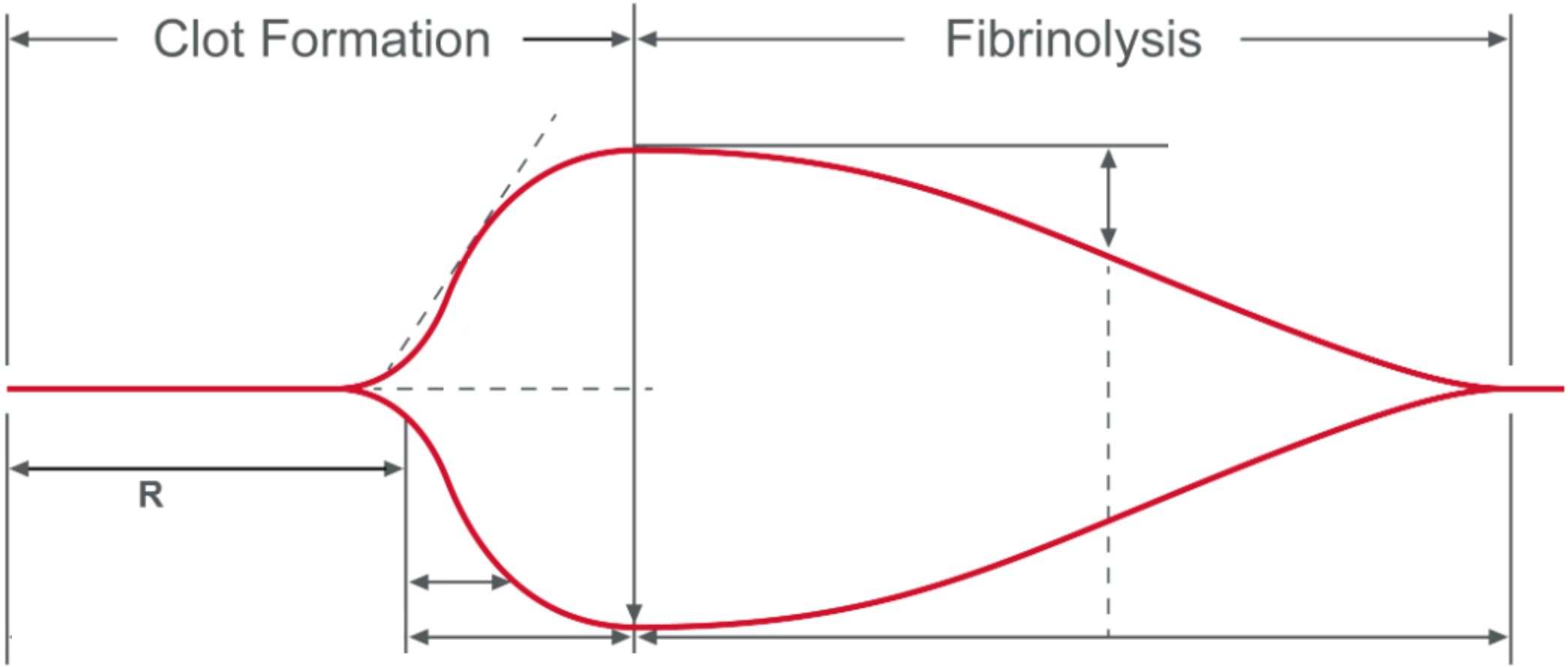

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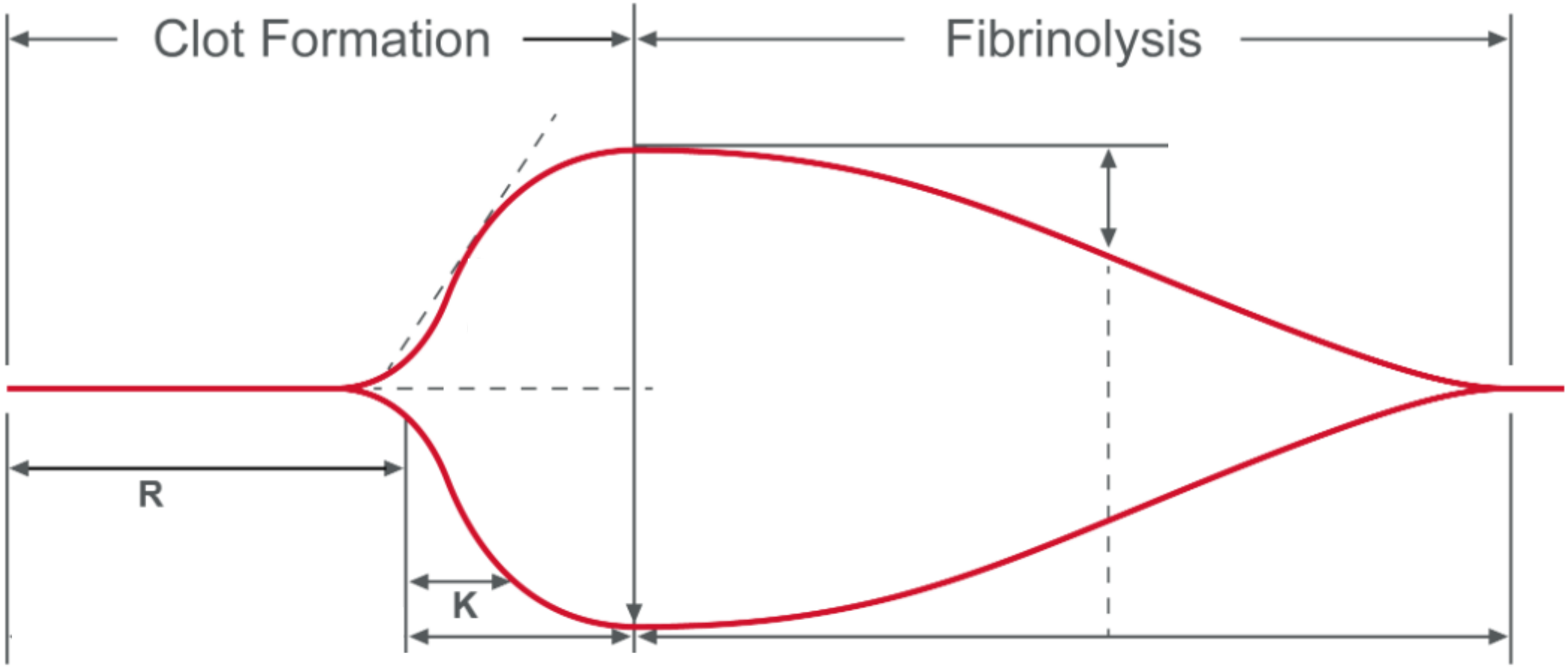

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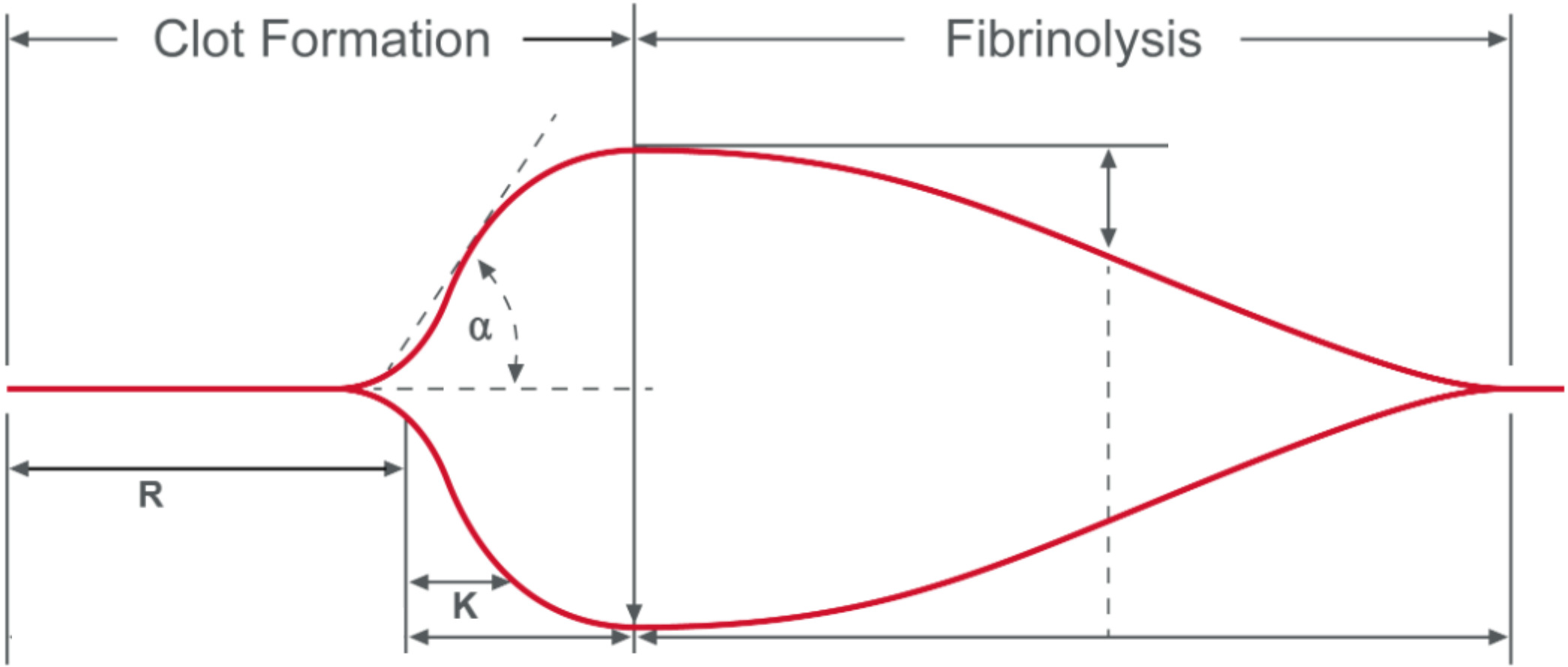

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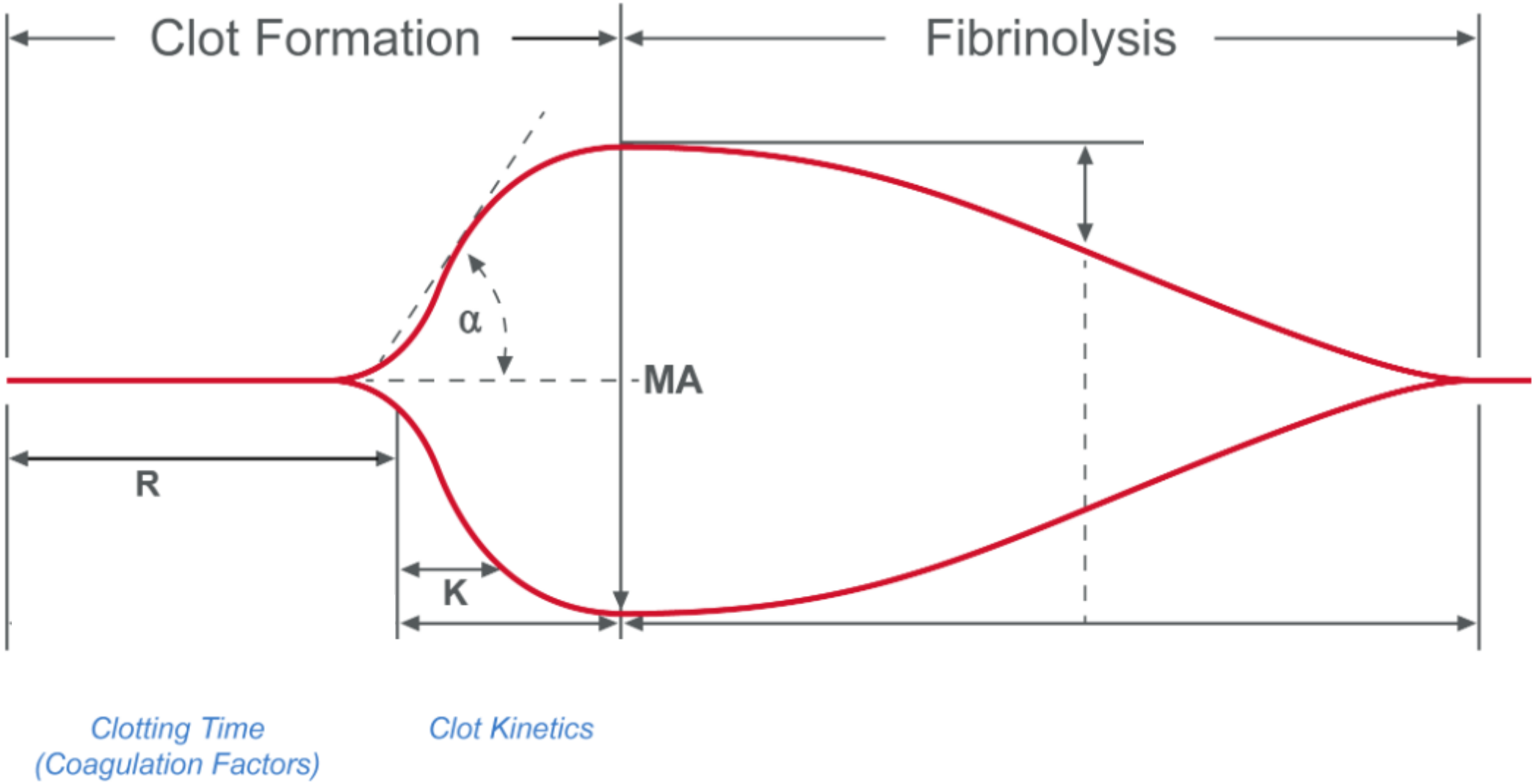

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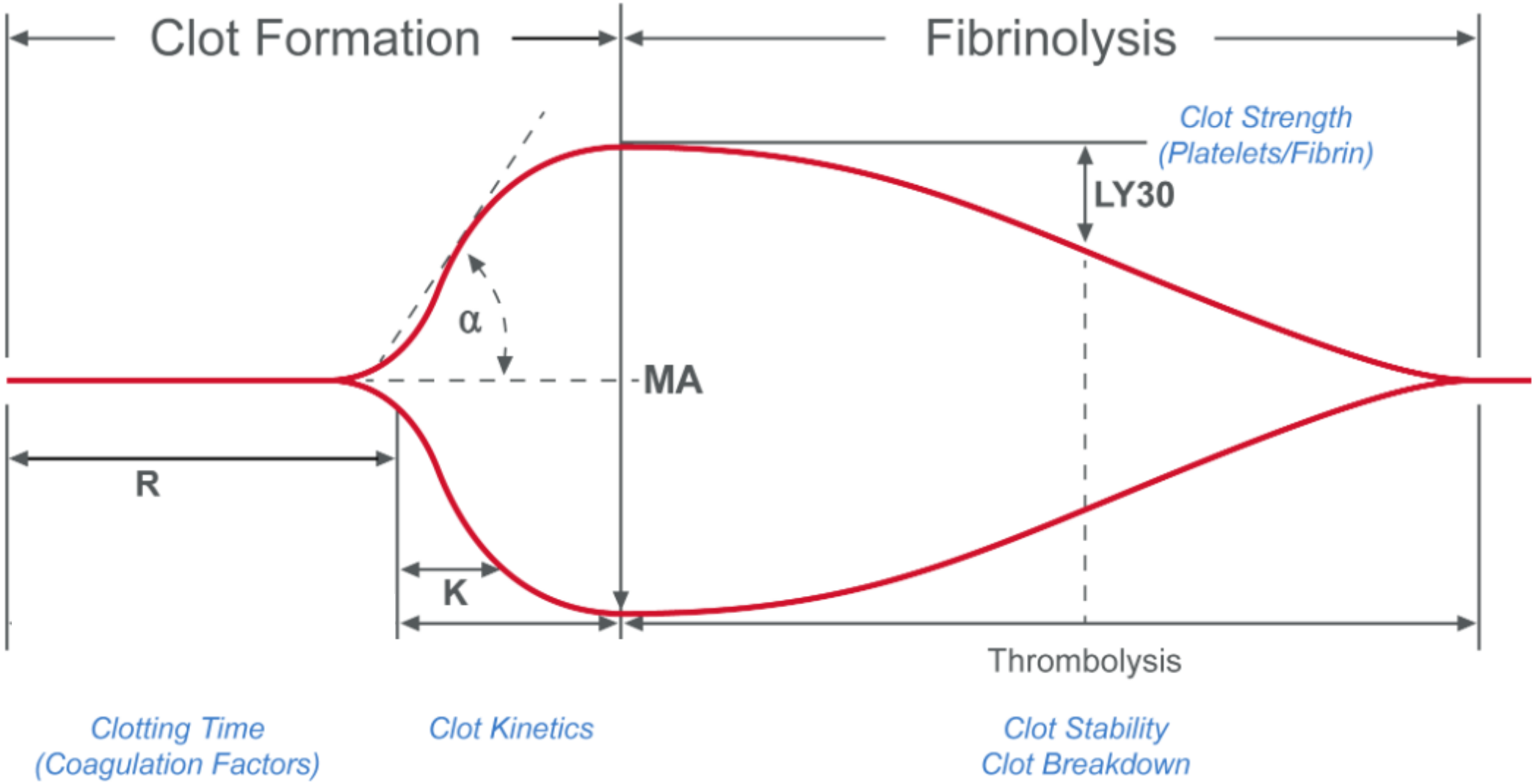

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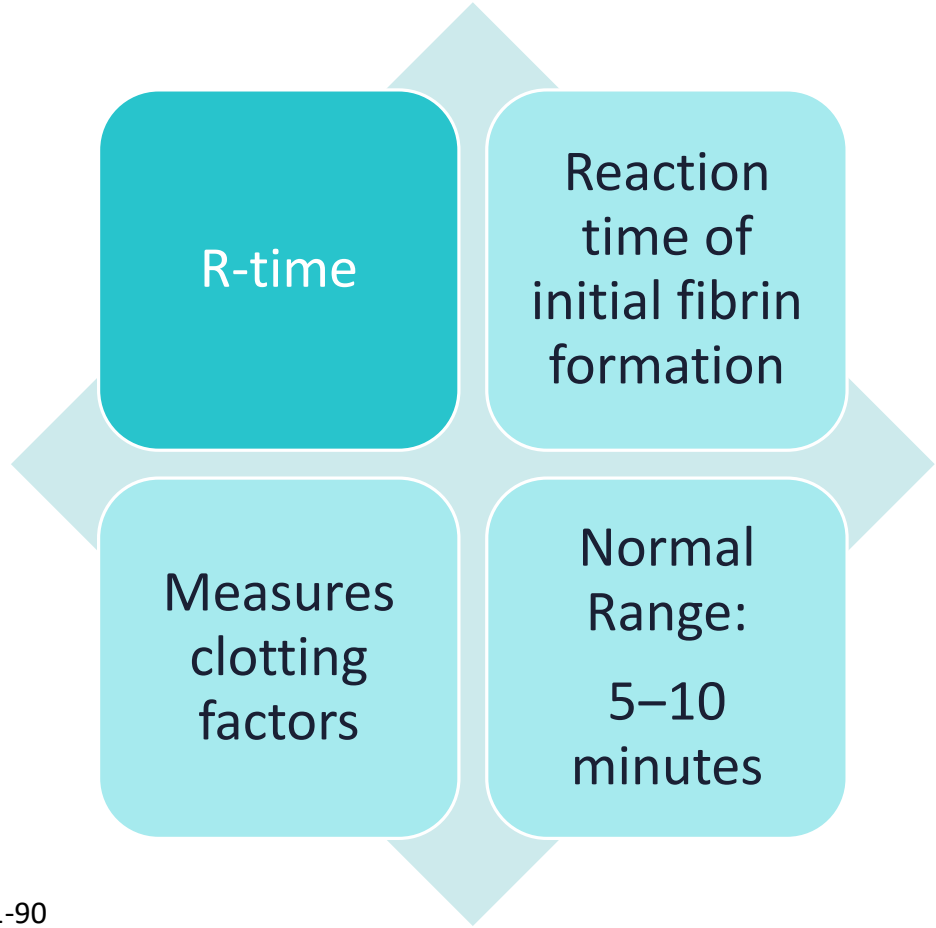
Components of TEG Tracing



Source: Luddington RJ. Clin Lab Haematol. 2005;27:81-90

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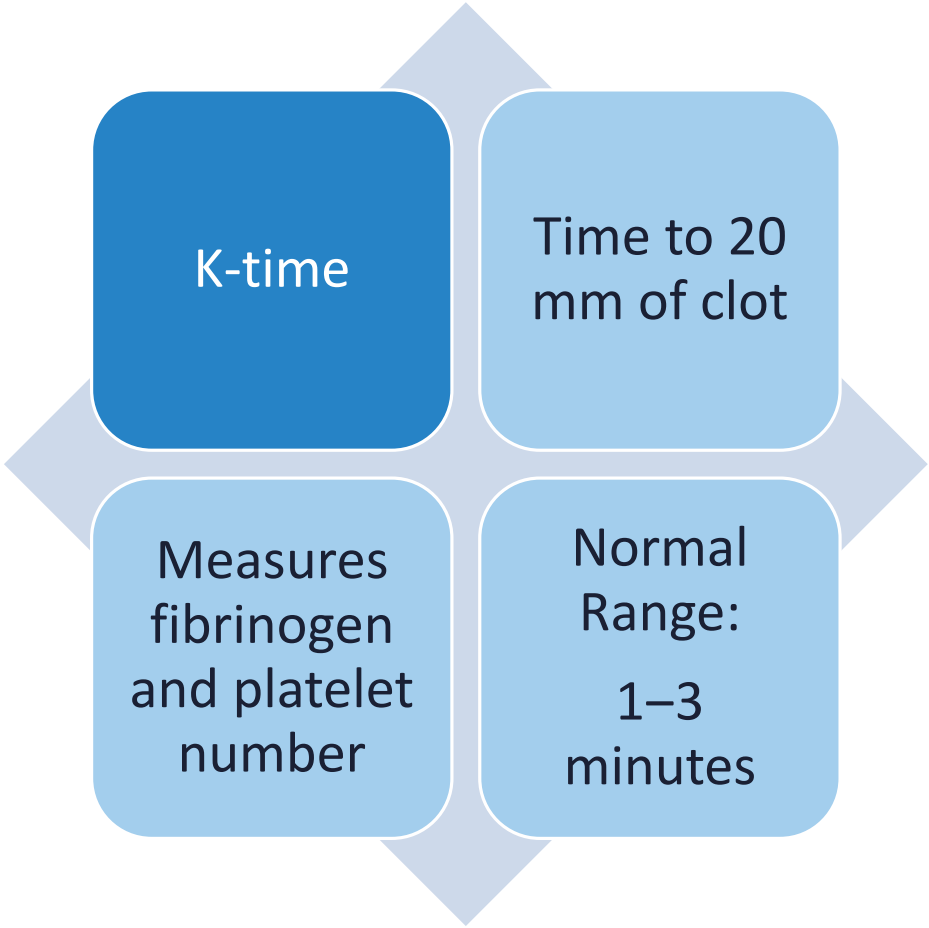

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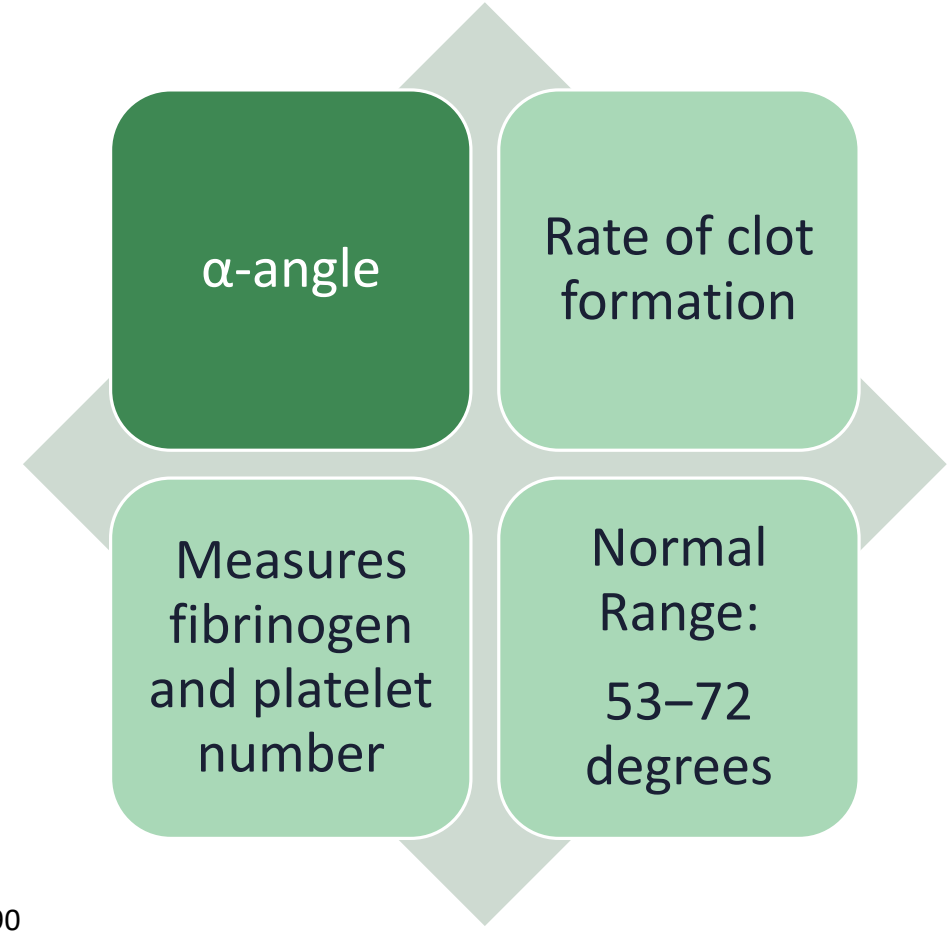

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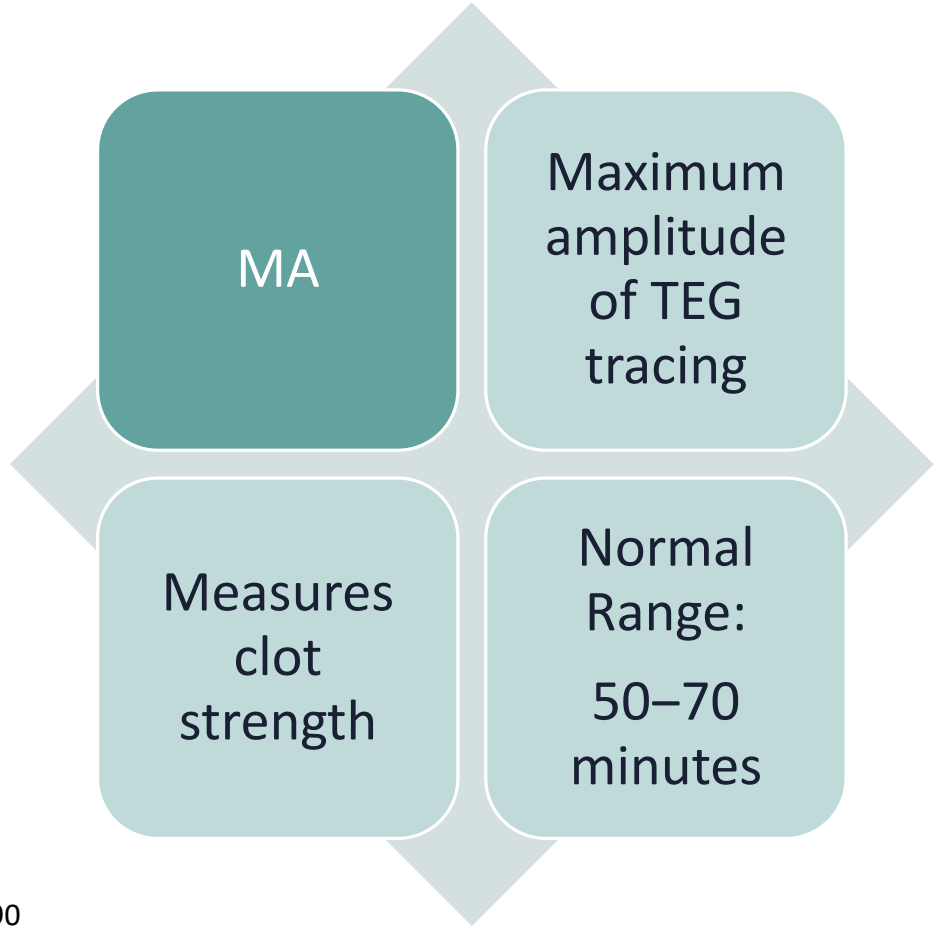

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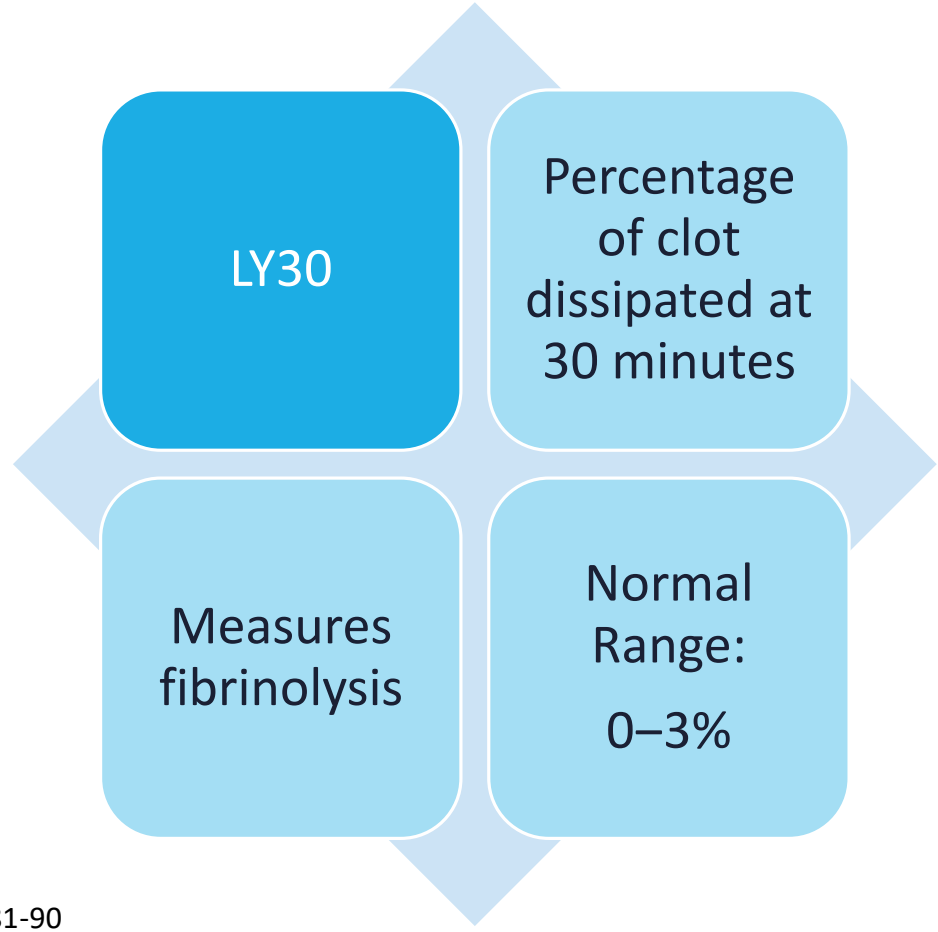

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TEG-guided Transfusion

TEG Value	Transfusion Recommendation
R-time >10	Fresh frozen plasma (FFP)
K-time >3	Cryoprecipitate
α-angle <53	Cryoprecipitate +/- platelets
MA <50	Platelets
LY30 >3%	Tranexamic acid (TXA)

Source: Luddington RJ. Clin Lab Haematol. 2005;27:81-90

Assessment Question #1

Which of the following represents a patient that is in a hypocoagulable state?

A. ↑ R-time, ↑ MA, ↓ LY30
B. ↓ R-time, ↑ MA, ↓ LY30
C. ↓ R-time, ↓ MA, ↑ LY30
D. ↑ R-time, ↓ MA, ↑ LY30

Assessment Response #1

Which of the following represents a patient that is in a hypocoagulable state?

A. ↑ R-time, ↑ MA, ↓ LY30

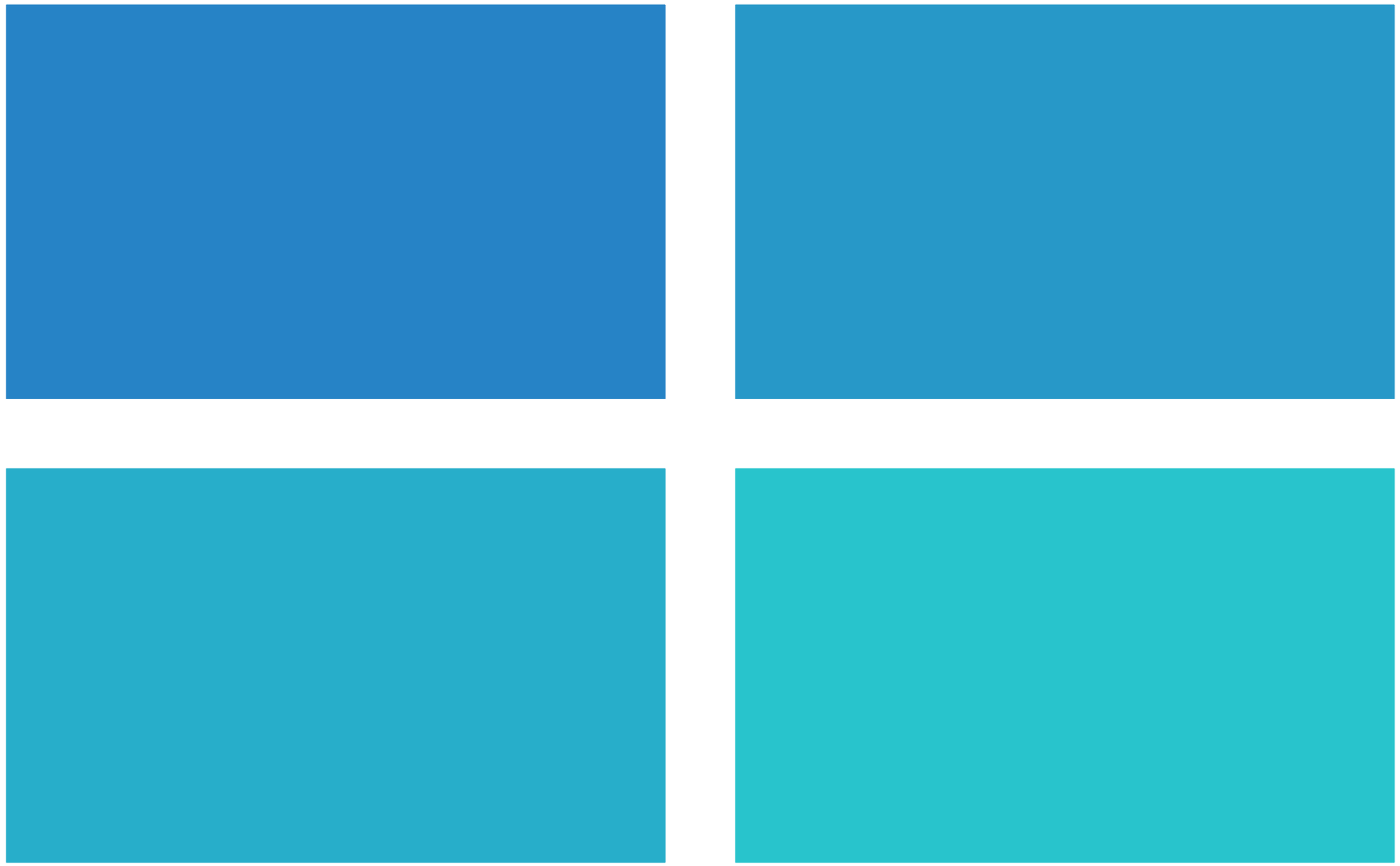
B. ↓ R-time, ↑ MA, ↓ LY30

C. ↓ R-time, ↓ MA, ↑ LY30

D. ↑ R-time, ↓ MA, ↑ LY30

The Role of TEGs

The Role of TEGs



The Role of TEGs

Hemostatic Monitoring in Liver Disease

The Role of TEGs

Hemostatic Monitoring in Liver Disease

TEG-guided Transfusion in Cardiac Surgery

The Role of TEGs

Hemostatic Monitoring in Liver Disease

TEG-guided Transfusion in Cardiac Surgery

Goal-Directed Transfusion Strategy in Trauma Patients

The Role of TEGs

- Hemostatic Monitoring in Liver Disease
- TEG-guided Transfusion in Cardiac Surgery
- Goal-Directed Transfusion Strategy in Trauma Patients
- Monitoring of Direct Oral Anticoagulants (DOACs)

Hemostatic Monitoring in Liver Disease

Liver Disease & Hemostatic Function

Procoagulant and Anticoagulant Proteins

- Decreased synthesis of factors II, VII, IX, X
- Decreased synthesis of protein C and S

Platelet Defects

- Decreased platelet adherence

Hyperfibrinolysis

- Decreased fibrinogen concentrations

Source: Stravitz RT, et al. J Hepatol. 2012;56(1):129-136

Minimal Effects of Liver Injury on Hemostasis Assessed by TEG

Bleeding diathesis based on elevated INR

Assess overall hemostasis

Prospective study of 51 patients

Mean INR was 3.4

Mean TEG parameters were normal

Normal coagulation parameters maintained

Stravitz RT, et al. J Hepatol. 2012;56(1):129-136

TEG-Guided Transfusion in Cardiac Surgery

Cardiac Surgery & Post-Operative Bleeding

Use of Anticoagulants

- Heparin and extracorporeal circulation: prevent coagulation

Extracorporeal Circuit Associated Trauma

- Decreased platelet number and function

Hypothermia

- Further impairs platelet function

Source: Spiess BD, et al. J Cardiothorac Vasc Anesth. 1995;9(2):168-173

Changes in Transfusion Therapy After Institution of Blood Management Program

Impact of coagulation and transfusion management

Retrospective study of 1,079 patients

Transfusion requirements, donor exposure, incidence of reoperation

Lower incidence of overall transfusion

Lower incidence of reoperation

TEG-Guided transfusion may decrease transfusion requirements

Source: Stravitz RT, et al. J Hepatol. 2012;56(1):129-136

Goal-Directed Transfusion in Trauma

Trauma Induced Coagulaopathy (TIC)

Increased Activation of Coagulation

- Uncontrolled coagulation

Coagulation Factor Deficiency

- Coagulation impairment leading to hypocoagulability

Increased fibrinolysis

- Can lead to catastrophic bleeding

Source: Kushimoto S, et al. J Intensive Care. 2017;5(6):1-7

TEG-guided Massive Transfusion Protocols (MTP)

TEG-Guided MTP	Fixed Transfusion Ratio 1:1:1	TEG-Guided MTP: improved mortality
TEG-guided MTP vs. Conventional coagulation assays (CCA)	TEG-guided MTP improved mortality (19% vs. 36%)	CCA: plasma and platelet units vs. TEG-guided: cryoprecipitate

Sources: Taipia NM, et al. J Trauma Acute Care Surg. 2013:74(2):378-385
Gonzalez E, et al. Crit Care Clin. 2017:33(1): 119-134

TEG-guided Characterization of TIC Phenotypes

Hyperfibrinolysis

- Hemorrhagic phenotype

Hypofibrinolysis

- Fibrinolytic shutdown

Physiologic fibrinolysis

Sources: Gonzalez E, et al. Crit Care Clin. 2017:33(1): 119-134
Walsh M, et al. Semin Thromb Hemost. 2017;43:213-223

Monitoring of DOACs

Direct Oral Anticoagulants (DOACs)

- Management Challenges
- No Reliable Methods to Detect and Monitor
- Limited Antidotes for Reversal

Sources: Iapichon GE, et al. Semin Throm Hemost. 2017;43:423-432
Dias JD, et al. Arch Pathol Lab Med. 2015;139:665-673

Use of TEG for Detection of New Oral Anticoagulants

Utilization of TEG	Monitor and differentiate between DOACs	Direct Thrombin Inhibitors & Factor Xa Inhibitors
R-time and MA were prolonged for apixaban and dabigatran	Capable of detecting and differentiating DOACS	Valuable tool to analyze hemostasis and effectiveness of reversal

Sources: Iapichon GE, et al. Semin Throm Hemost. 2017;43:423-432
Dias JD, et al. Arch Pathol Lab Med. 2015;139:665-673

Patient Case

RD is a 18-year old male who was involved in an MVC vs. pedestrian trauma. He was stabilized at an outside hospital and sent to your hospital for further evaluation. The trauma surgeon has the results of the patient's TEG from the outside hospital and asks for your recommendation on transfusion for the patient. The patient's TEG results are below:

R-time: 7

K-time: 1

α-angle: 78

MA: 84

LY30: 10%

Assessment Question #2

What can you conclude from RD's TEG analysis?

A. His R-time indicates that his time to clot initiation is prolonged
B. His K-time indicates that his time to 20 mm clot is prolonged
C. His MA indicates that his clot strength is minimal
D. His LY30 indicates that he is in a fibrinolytic state

Assessment Response #2

What can you conclude from RD's TEG analysis?

A. His R-time indicates that his time to clot initiation is prolonged
B. His K-time indicates that his time to 20 mm clot is prolonged
C. His MA indicates that his clot strength is minimal
D. His LY30 indicates that he is in a fibrinolytic state

Assessment Question #3

What pharmacologic therapy would you recommend for RD?

A. Tranexamic acid
B. Platelets
C. Cryoprecipitate
D. RD does not require any pharmacologic intervention

Assessment Response #3

What pharmacologic therapy would you recommend for RD?

A. Tranexamic acid

B. Platelets

C. Cryoprecipitate

D. RD does not require any pharmacologic intervention

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Thank You!

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