

Thromboelastography for Bleeding Management

Nick Schofield
Consultant Anaesthetist
Royal Free London



Contents

- Coagulation
- Thromboelastography
- Case studies



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Thromboelastography

Thromboelastography can be used to guide transfusion of clotting products

In combination with patient blood management strategies (single unit transfusion, low Hb targets), it can reduce unnecessary transfusion and save costs

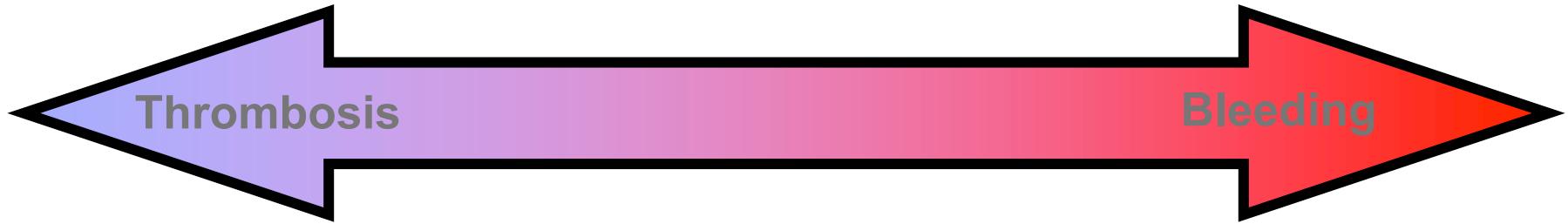


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The Coagulation Continuum

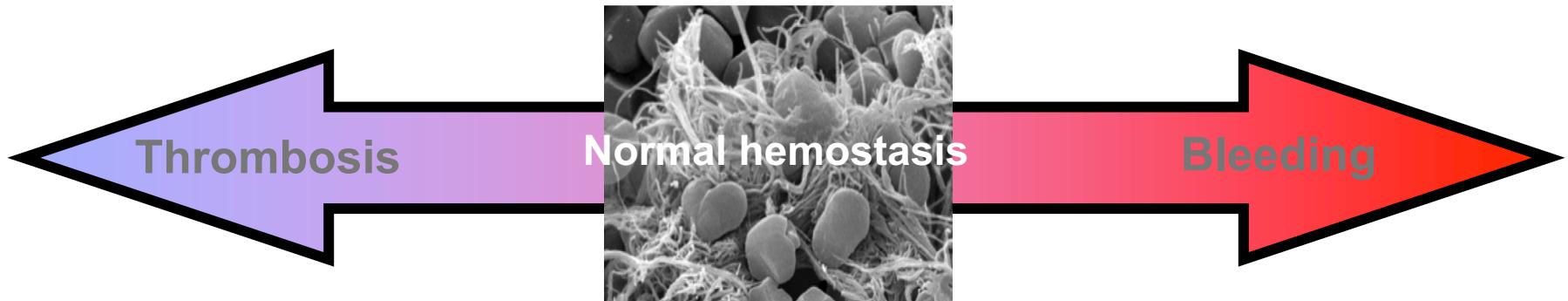


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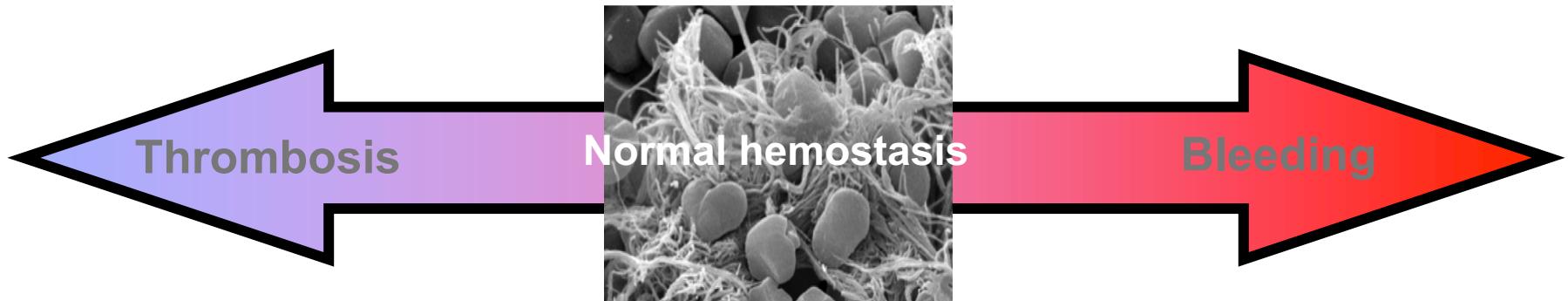


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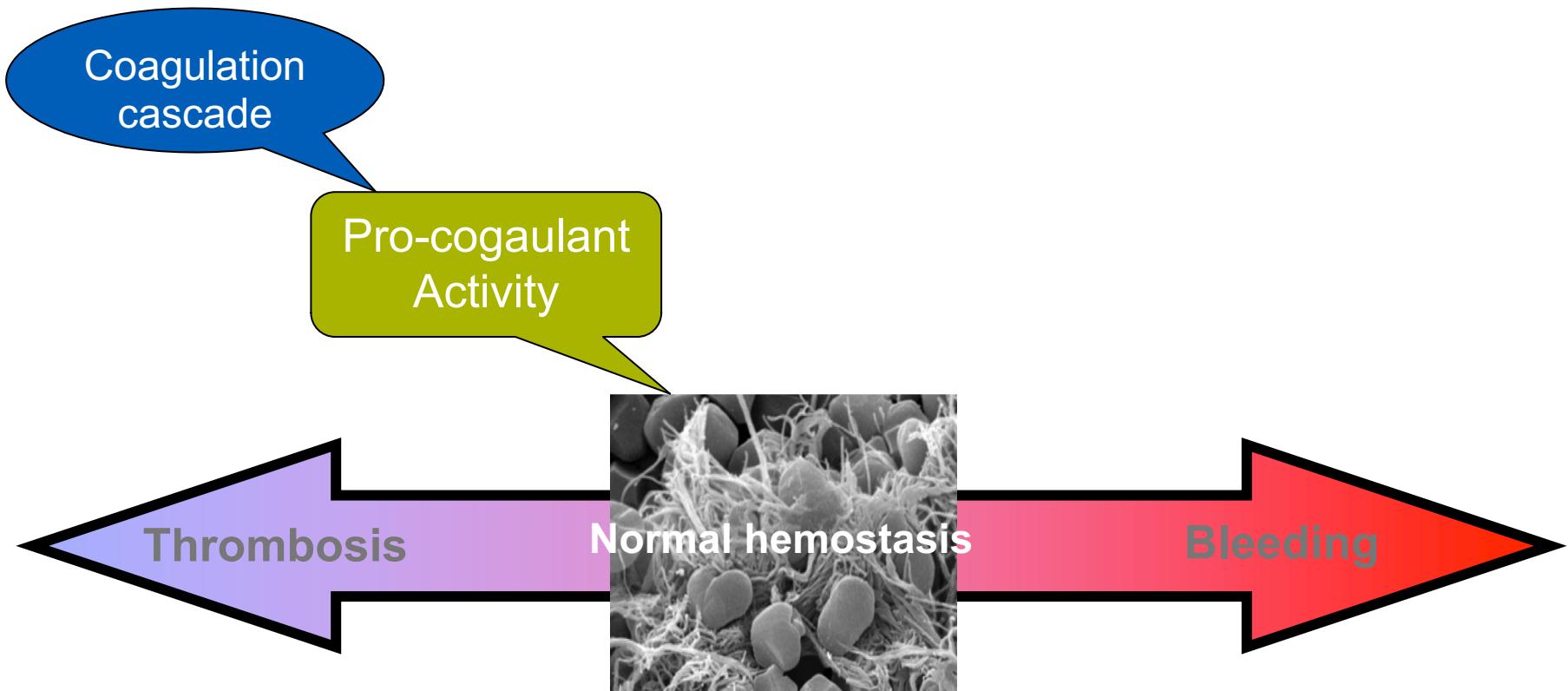


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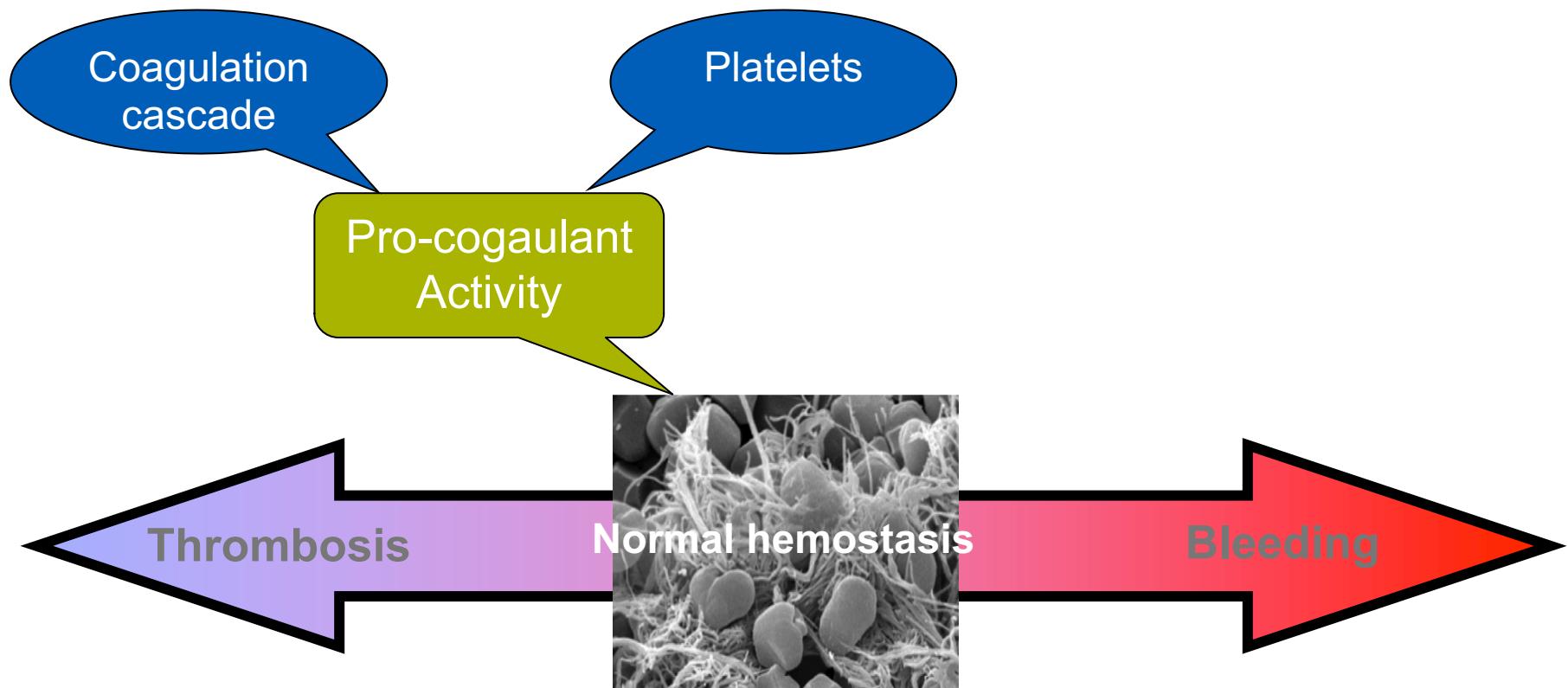


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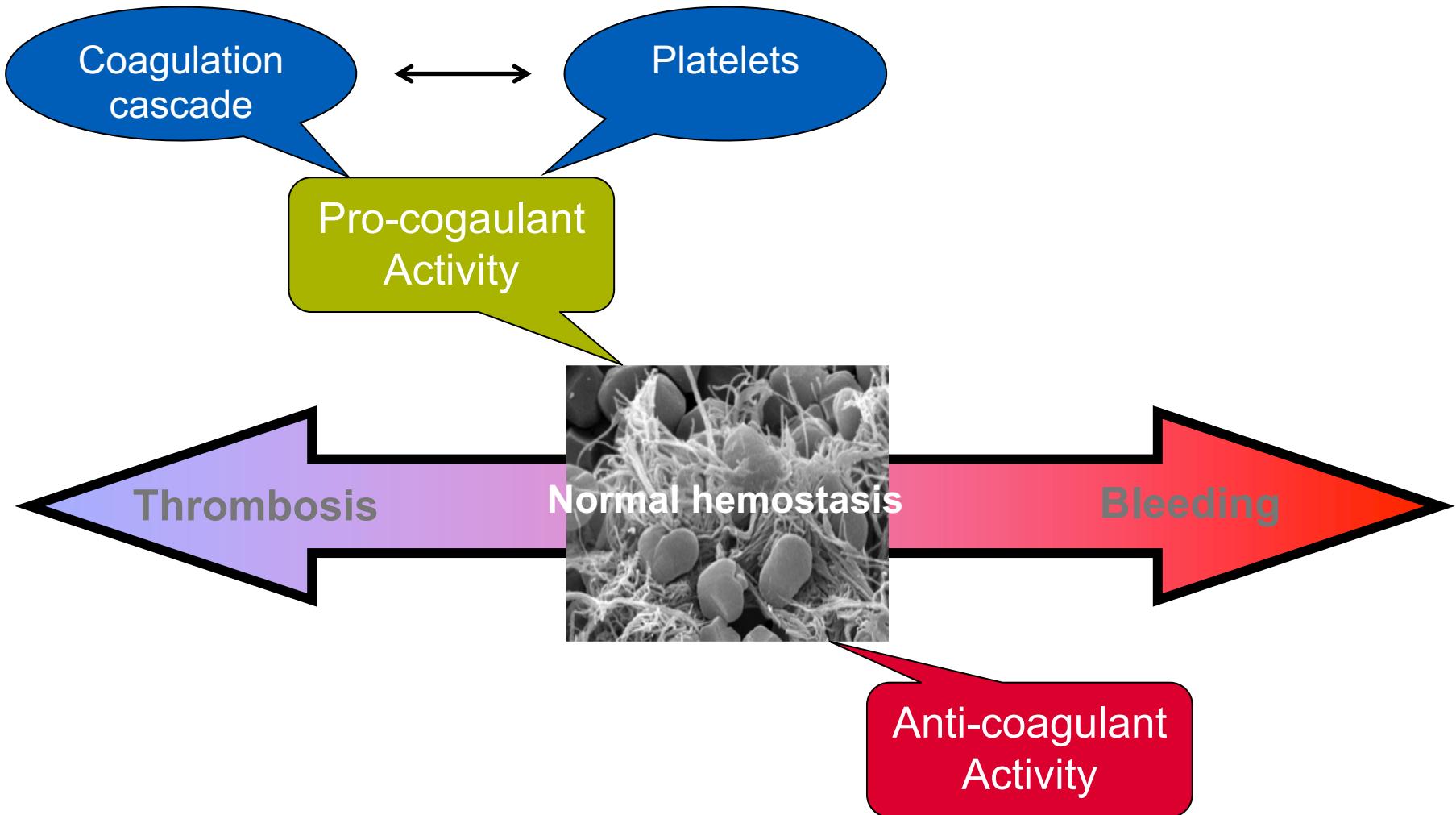


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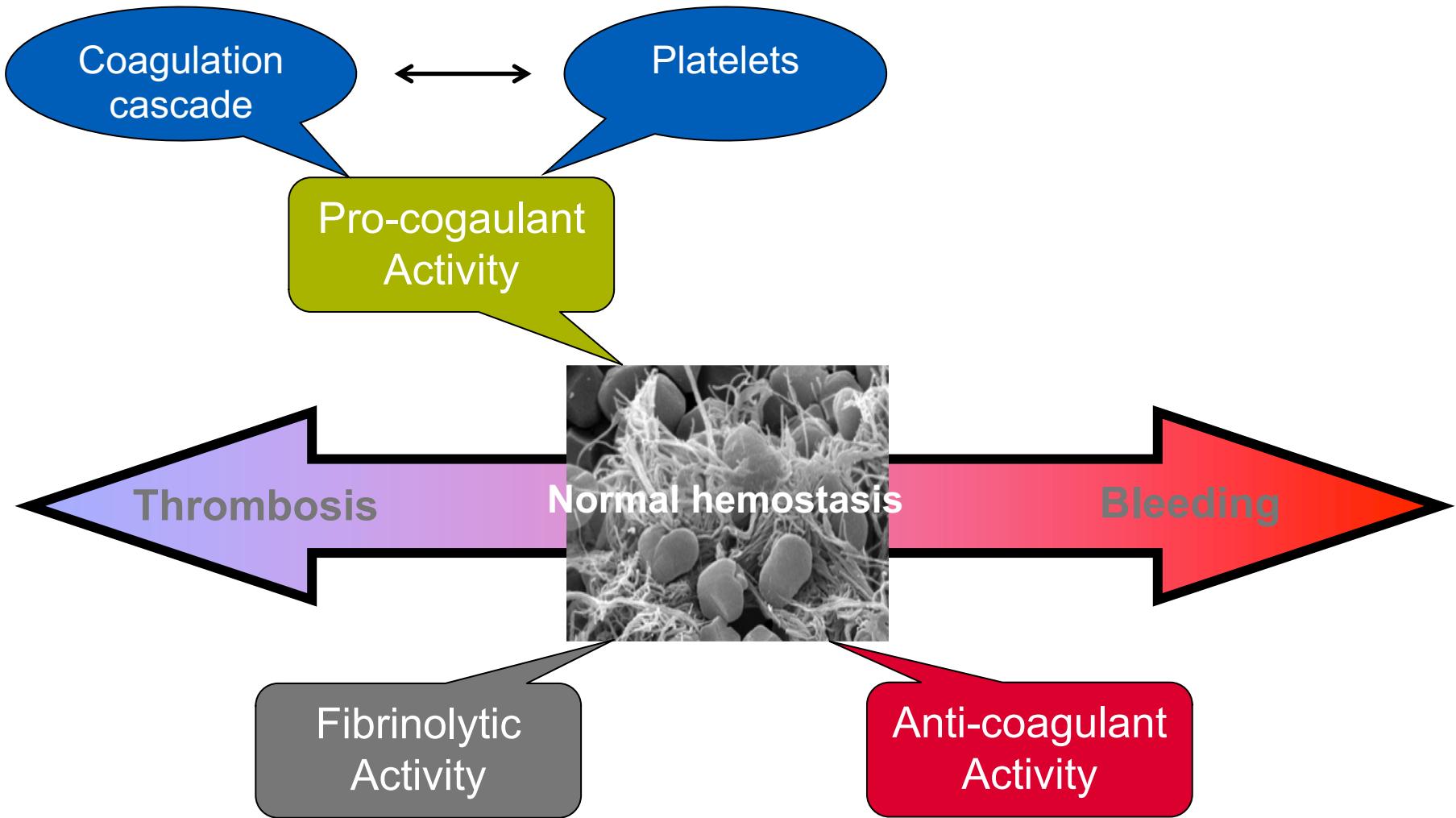
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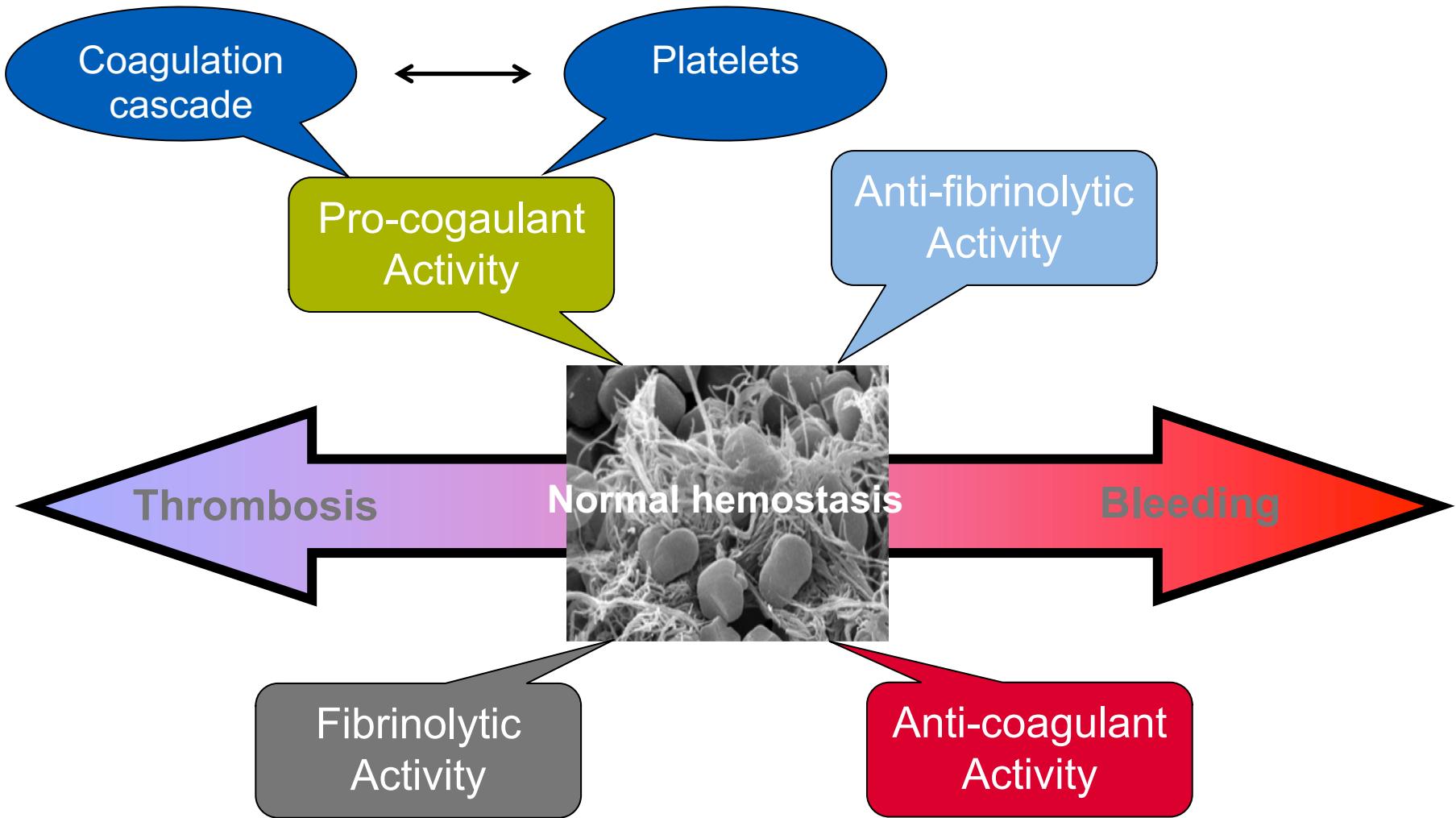
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Traditional Hemostasis Monitoring

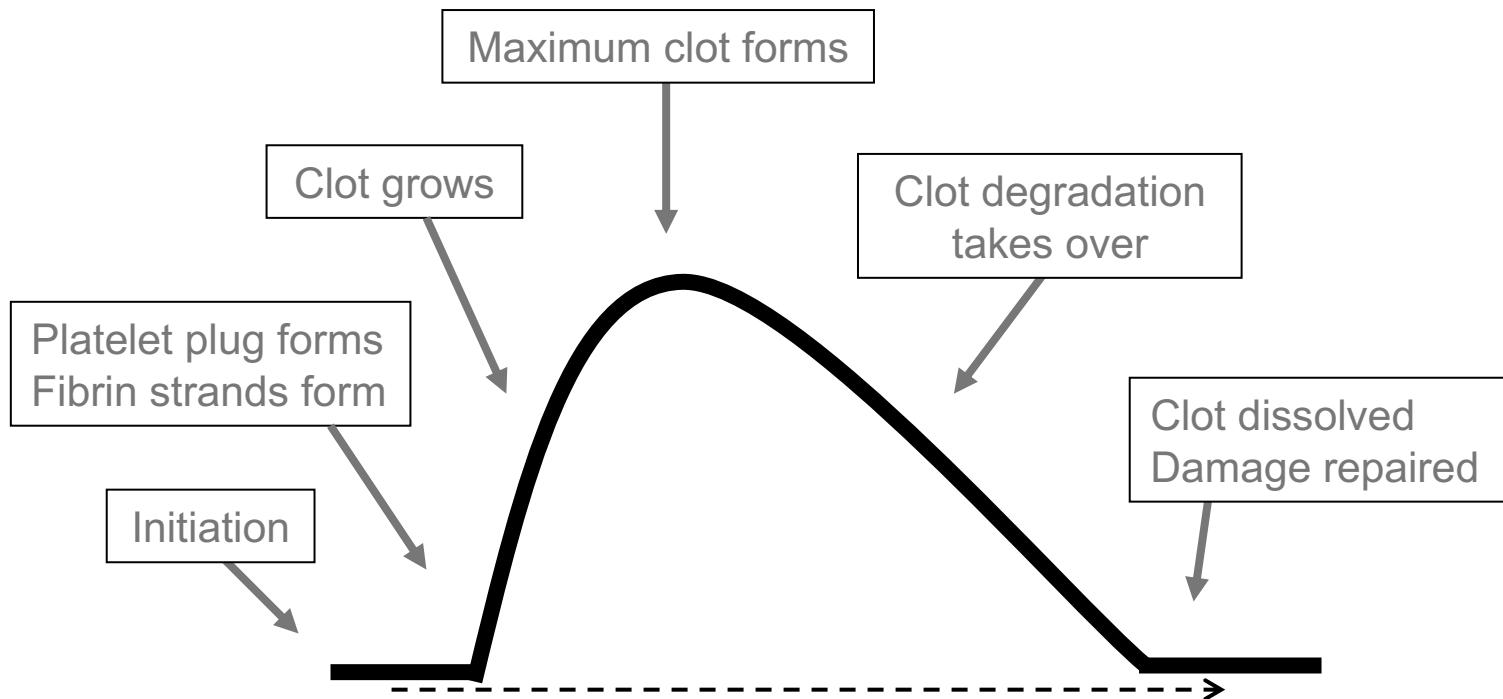


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Traditional Hemostasis Monitoring



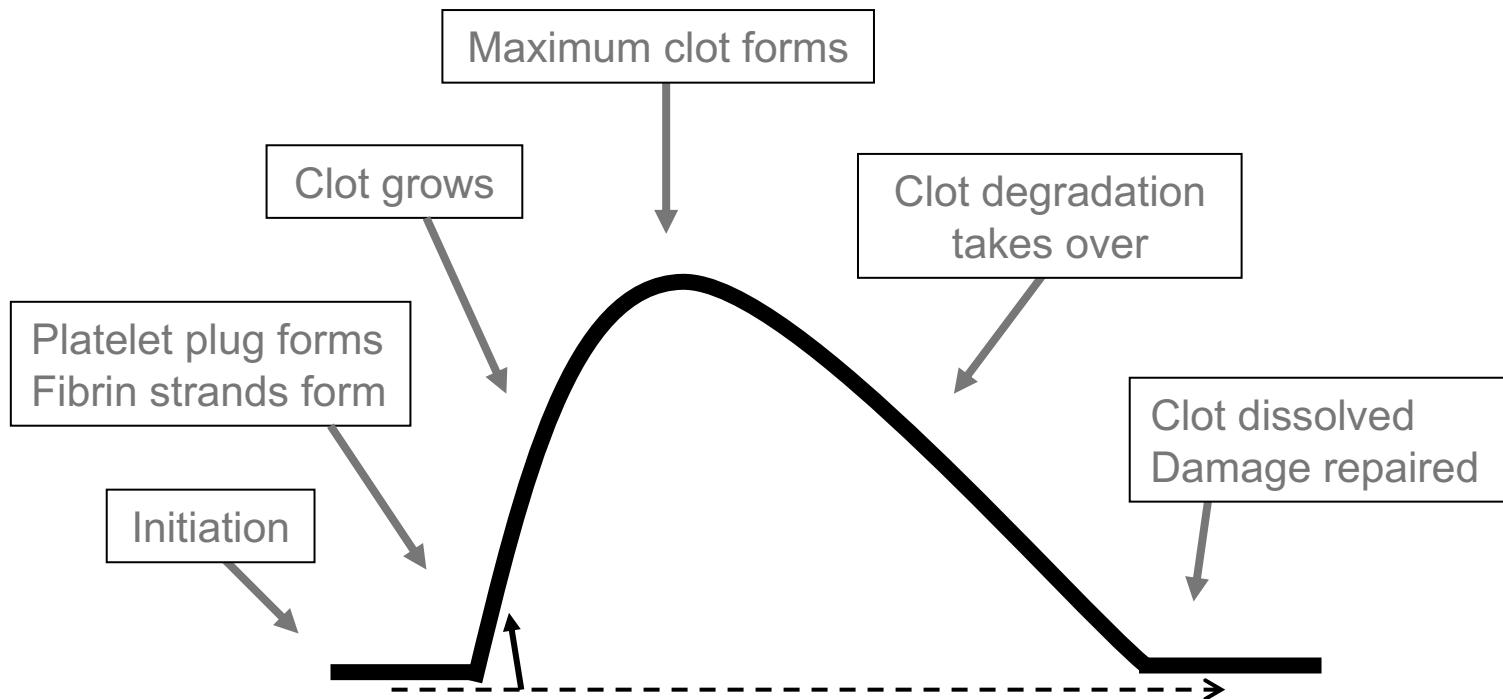
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Traditional Hemostasis Monitoring



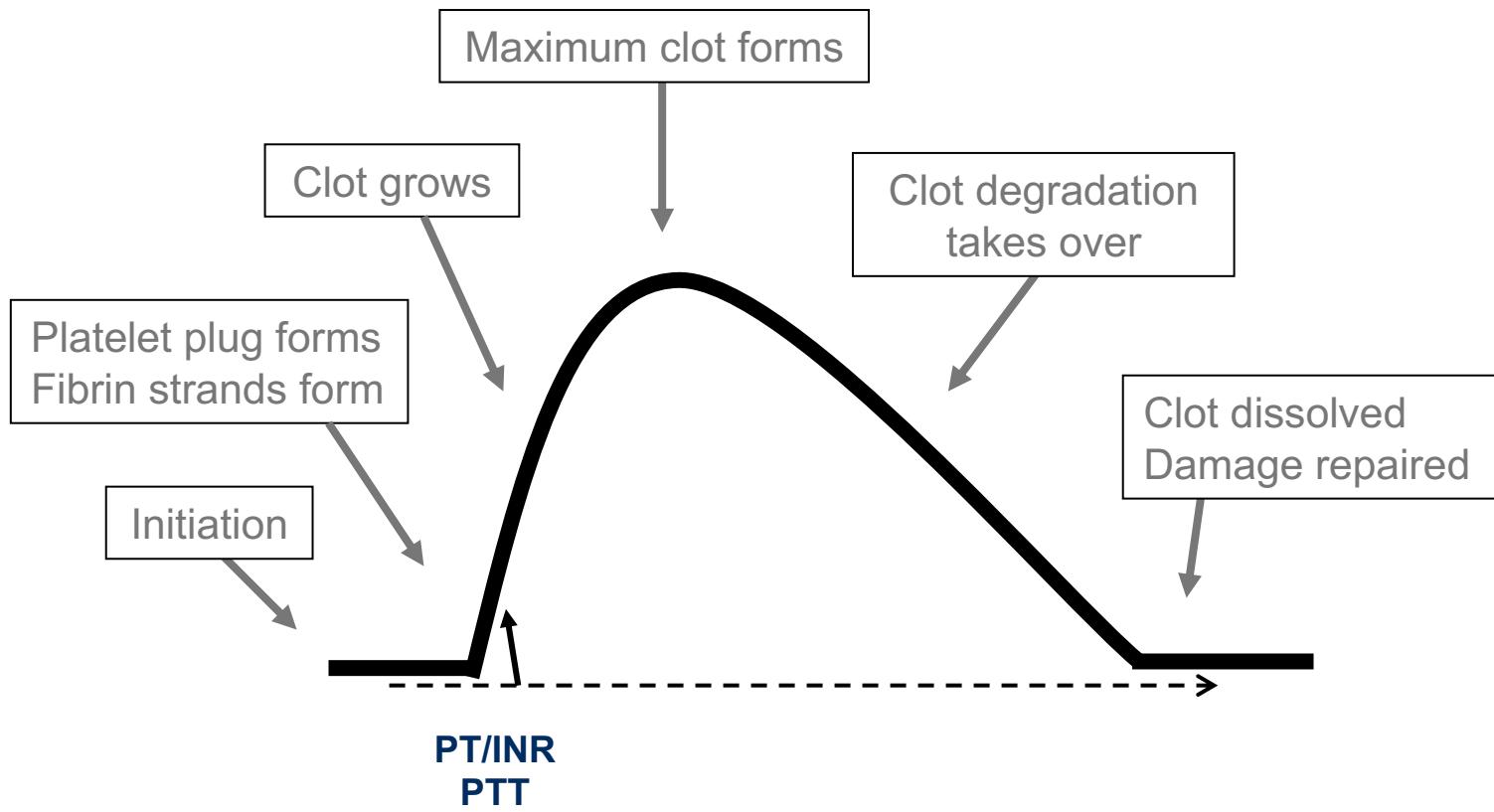
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Traditional Hemostasis Monitoring



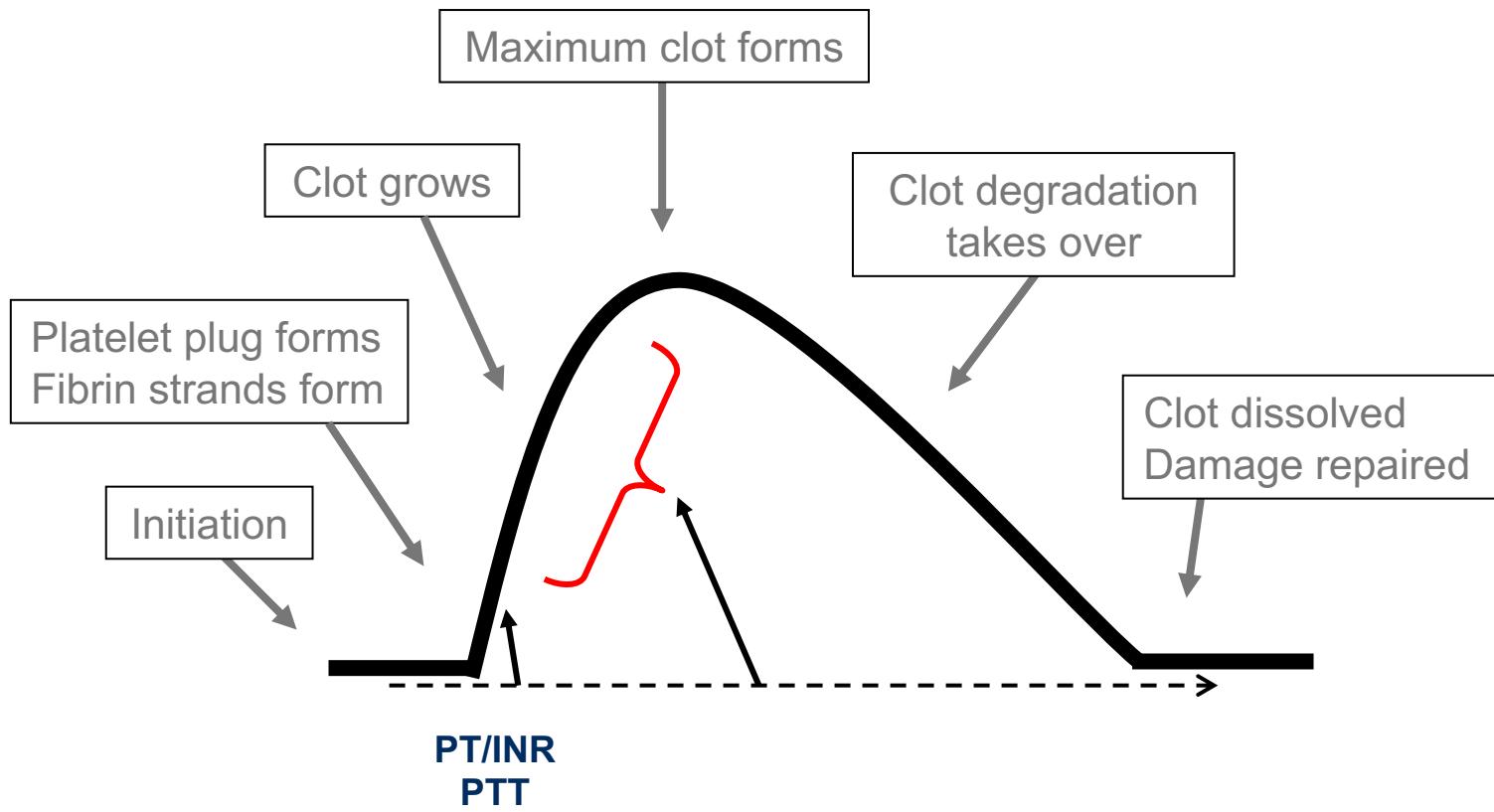
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Traditional Hemostasis Monitoring



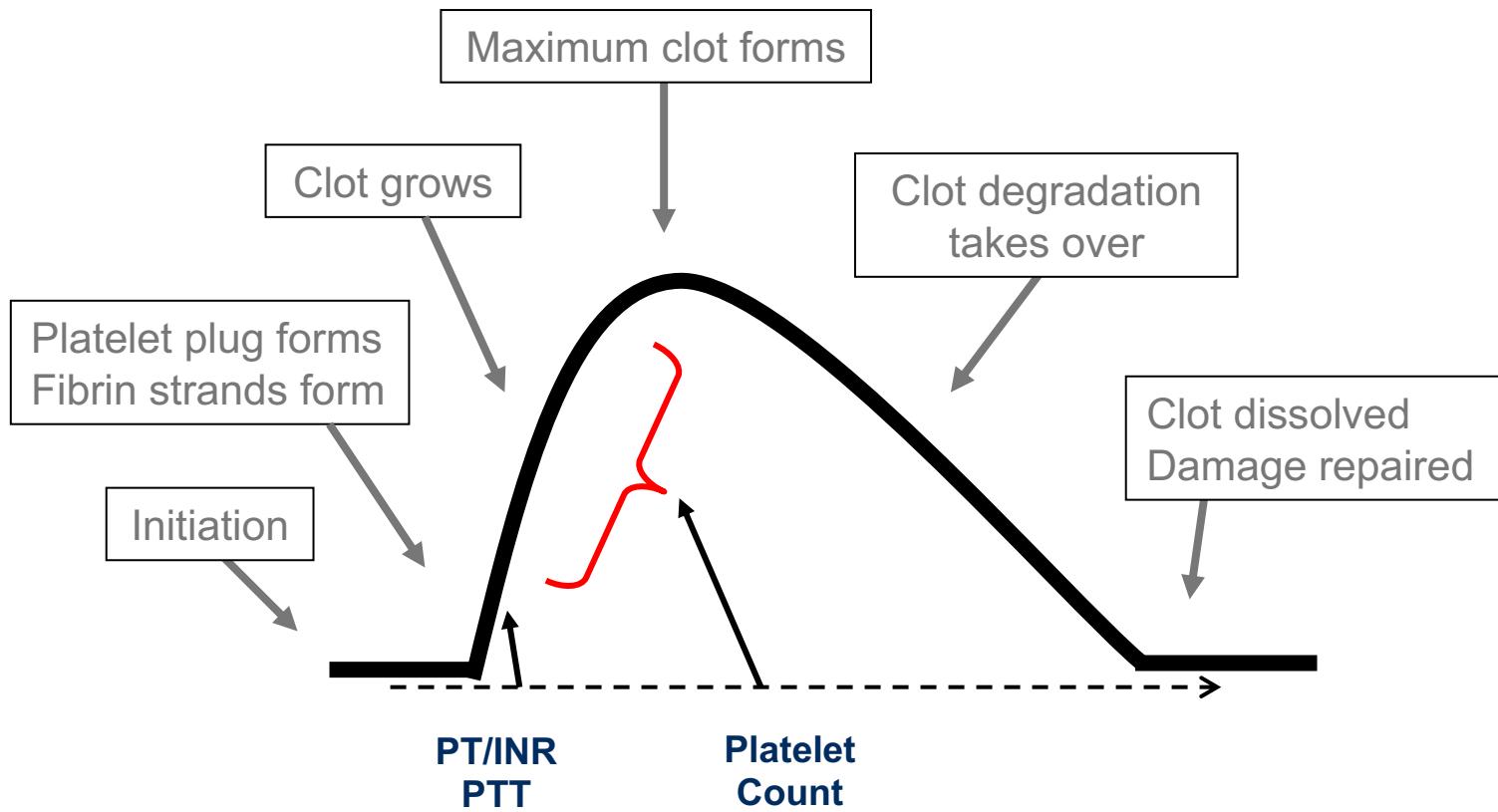
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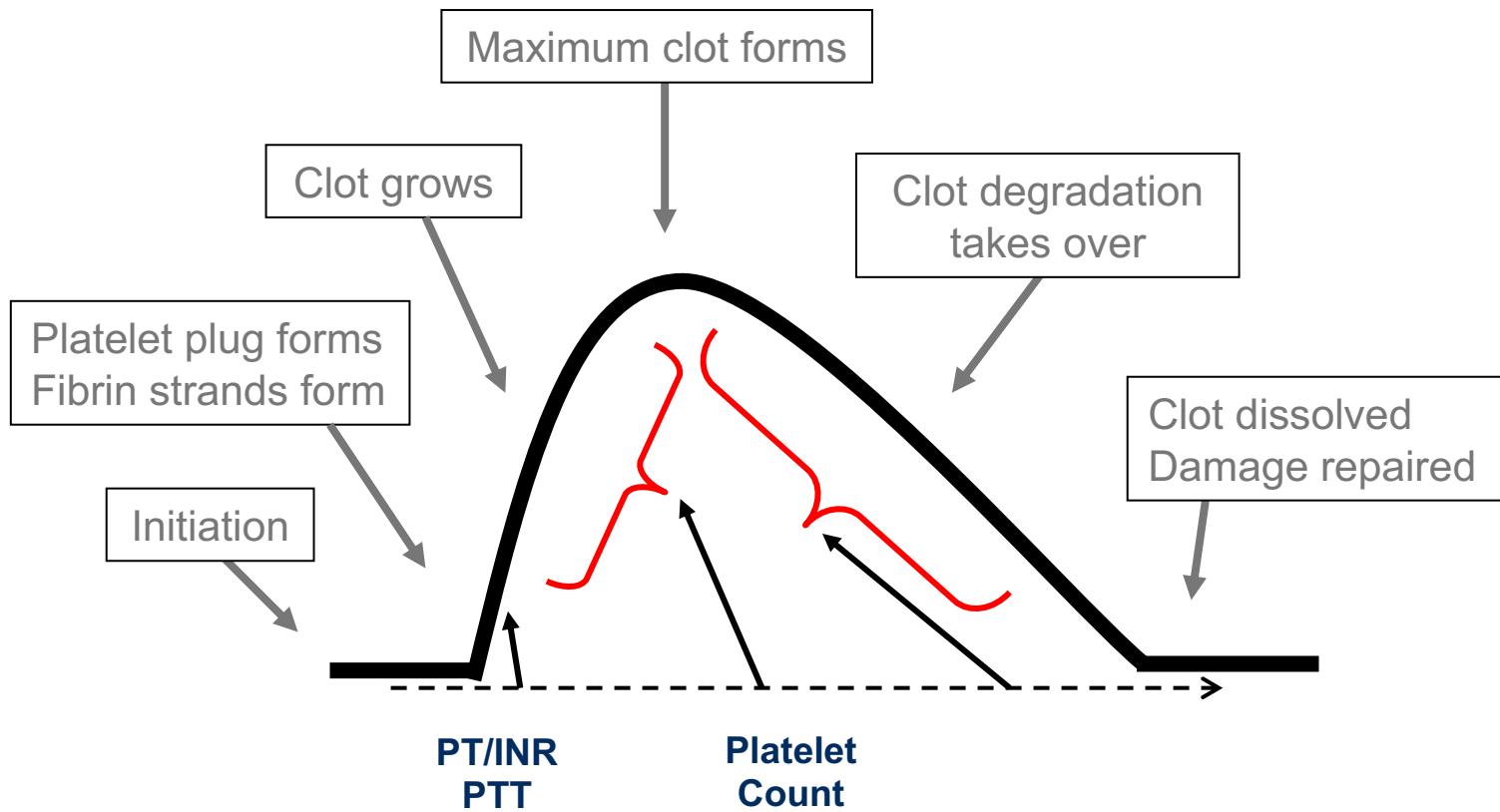


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Traditional Hemostasis Monitoring



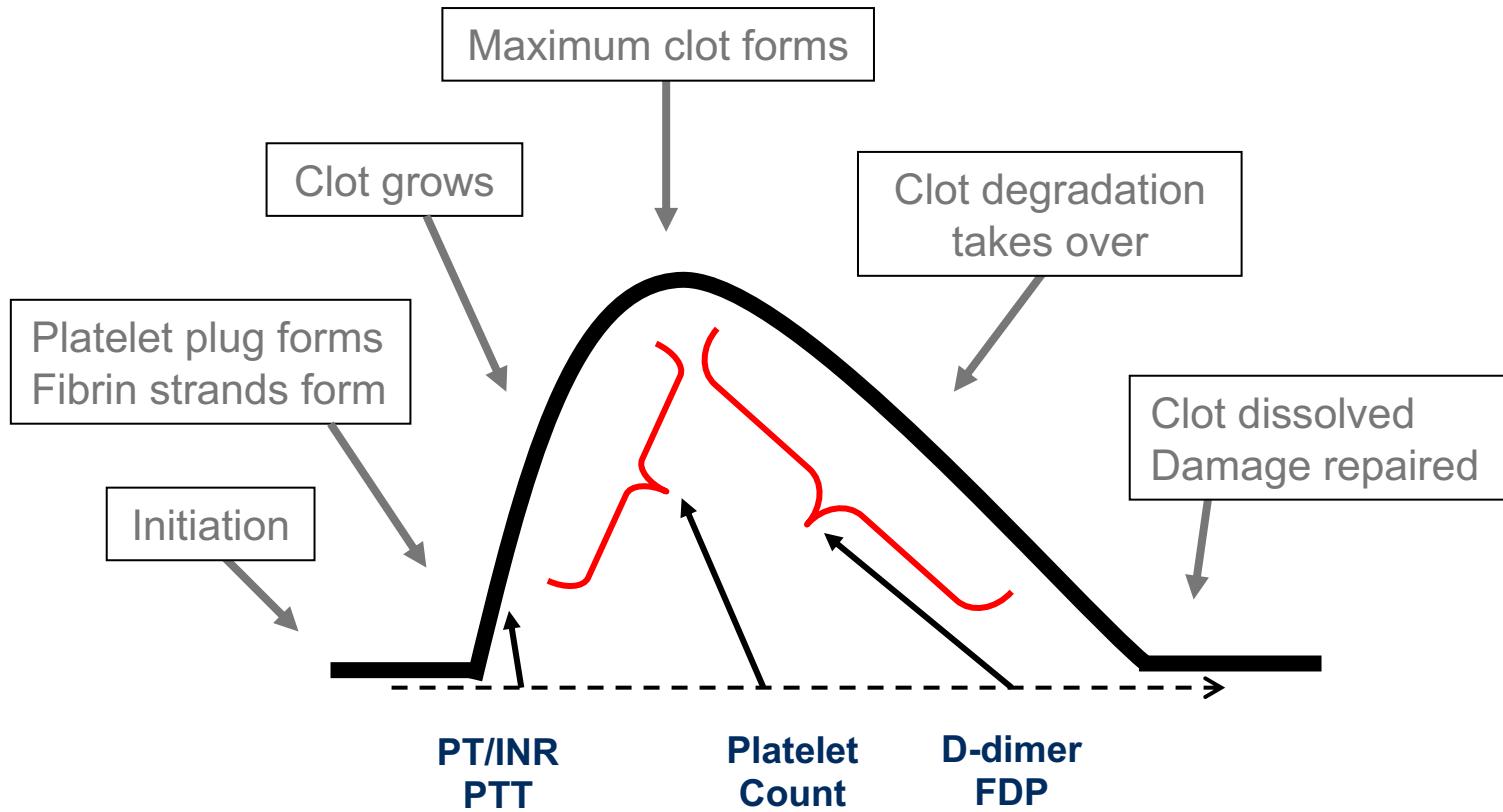
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Traditional Hemostasis Monitoring

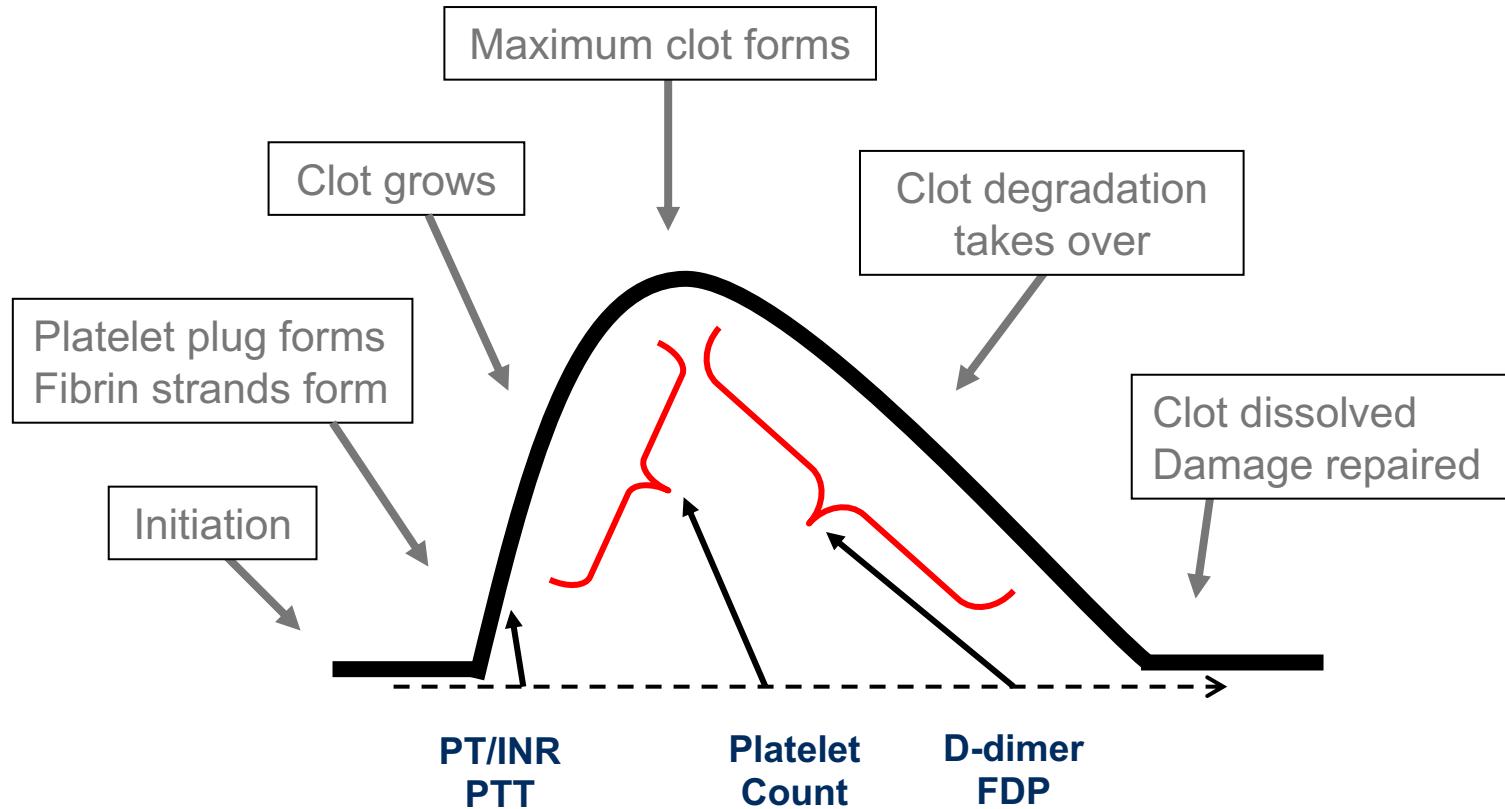


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Traditional Hemostasis Monitoring



Traditional
Hemostasis
Tests

Do not define the overall process, just provide pieces of the process!



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What are the problems?

- CCTs poorly reflect in vivo coagulation
- Single point
- Significant time delays
- May result in under, over or inappropriate treatment
- Adoption as gold standard &/or standard of care without rigorous testing



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Thromboelastography

- A method of detecting the efficiency of coagulation in whole blood
- Real time measurement of clot strength over time
- End result of haemostatic process is the **CLOT**
- The **Rate, Strength and Stability** of clot formation will determine a patients risk of coagulopathic bleeding or thrombosis
- Whole blood sample – interactive & global process



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TEG Trace



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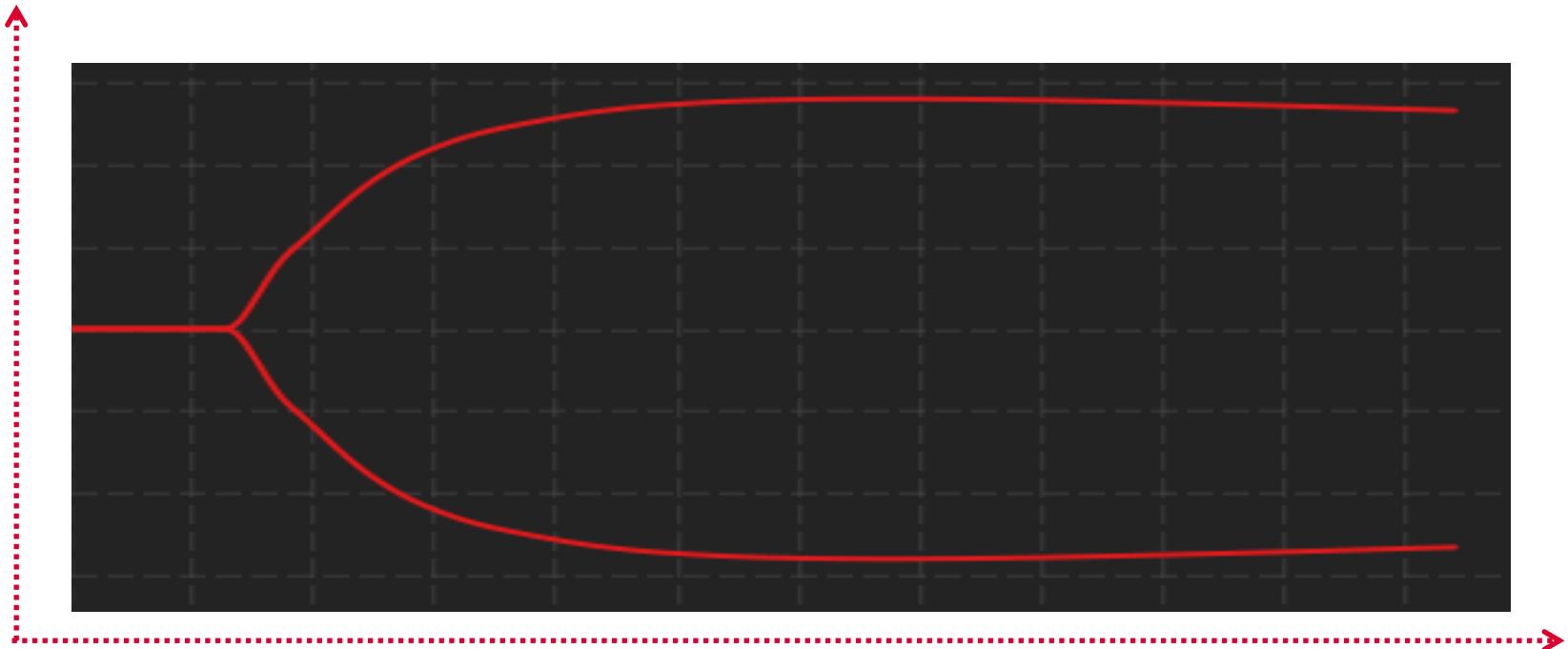


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Reaction time
(mins)
RATE



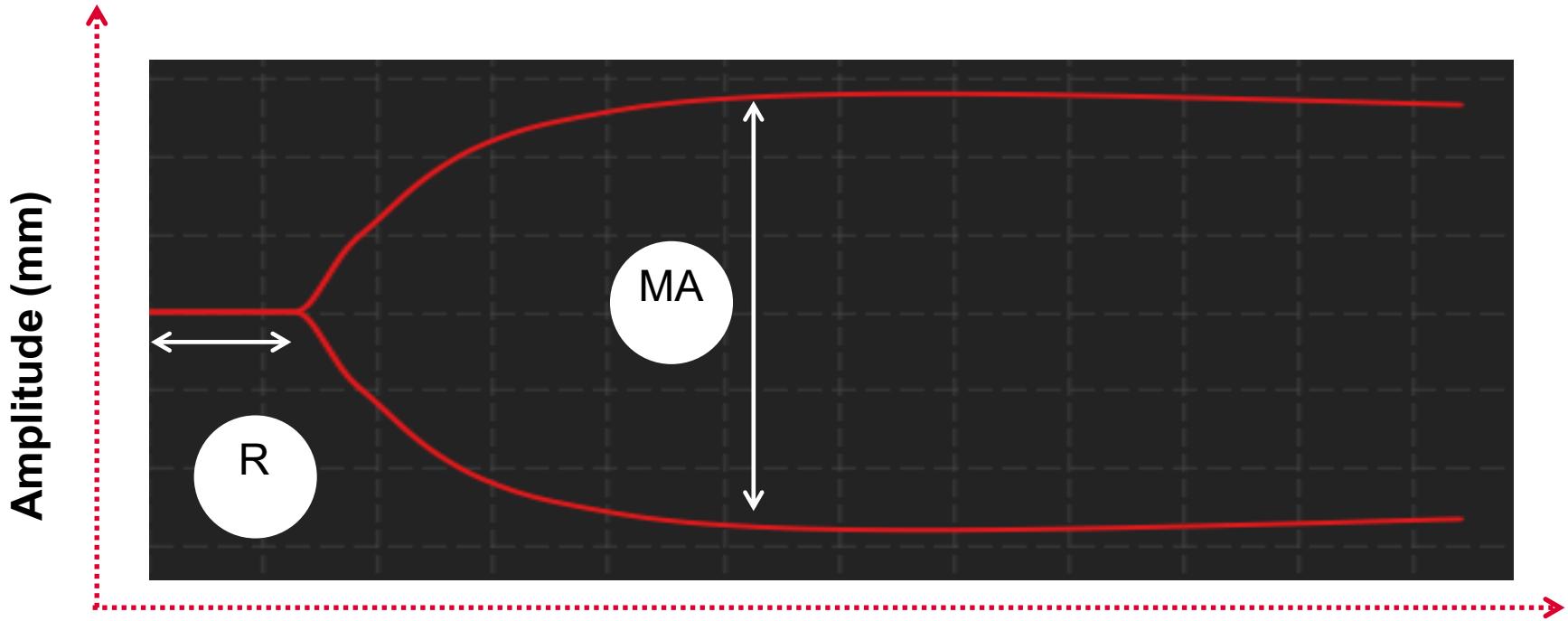
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TEG Trace



Reaction time
(mins)
RATE

Maximum Amplitude
(mm) **STRENGTH**



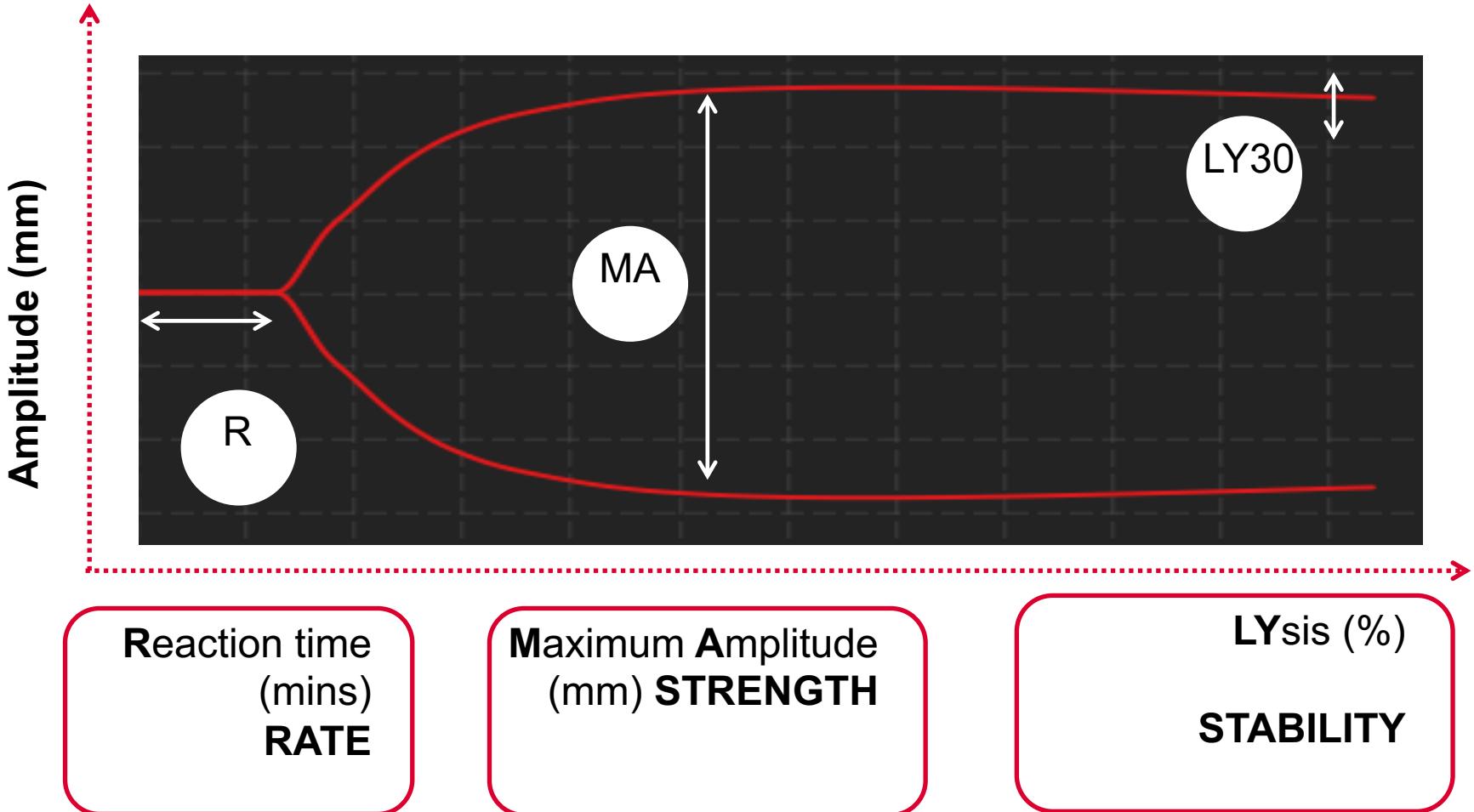
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TEG Trace



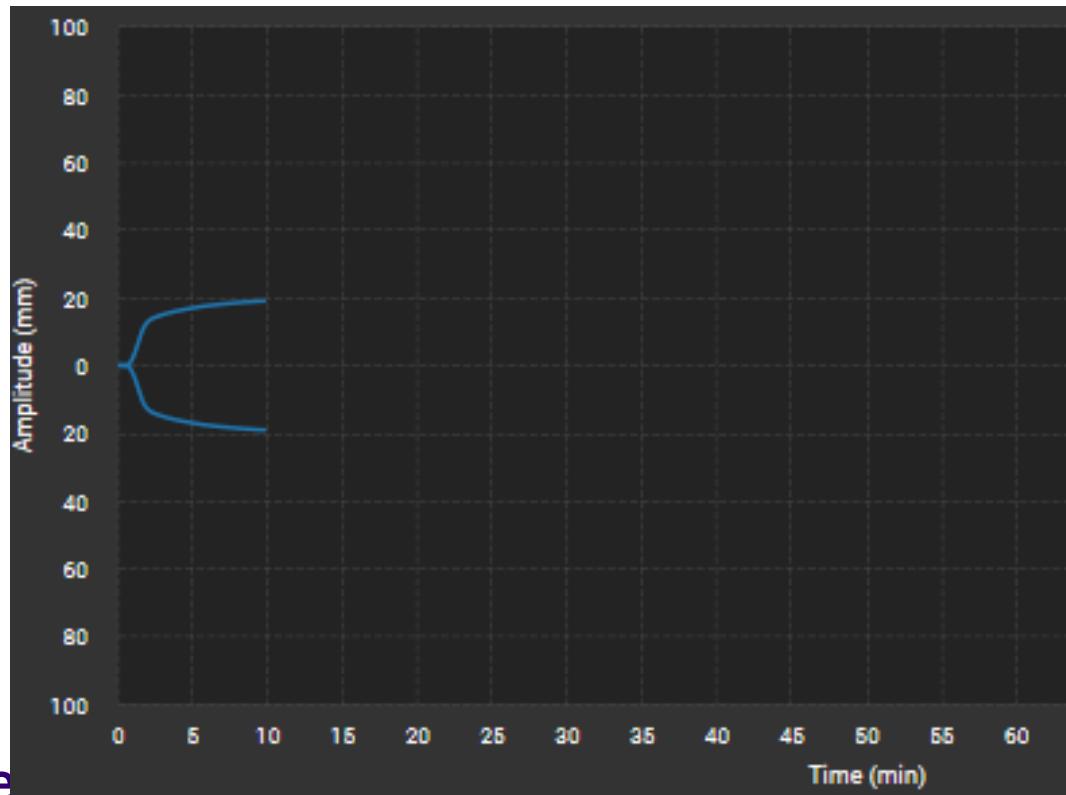
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Clot Strength - MA



world class expertise

young carers

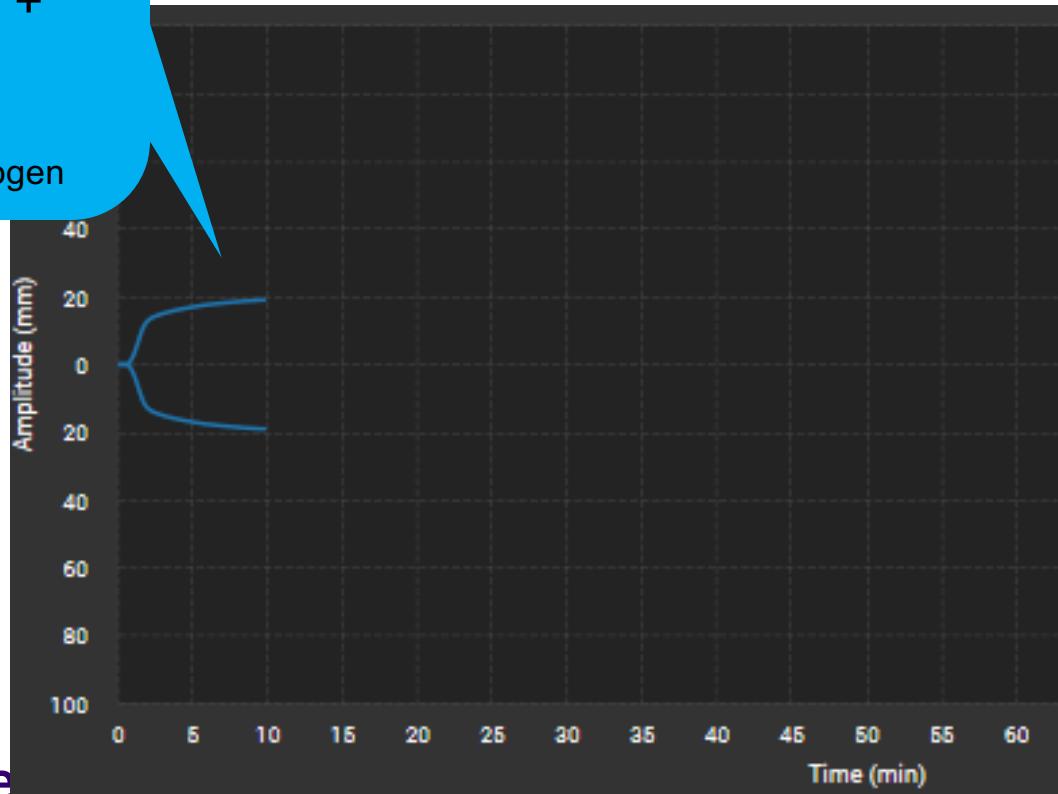
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Clot Strength - MA

Functional Fibrinogen®
(CFF)

Maximally Activated +
Platelet Inhibitor

Specific assessment of fibrinogen



world class expertise

young and dynamic

NHS

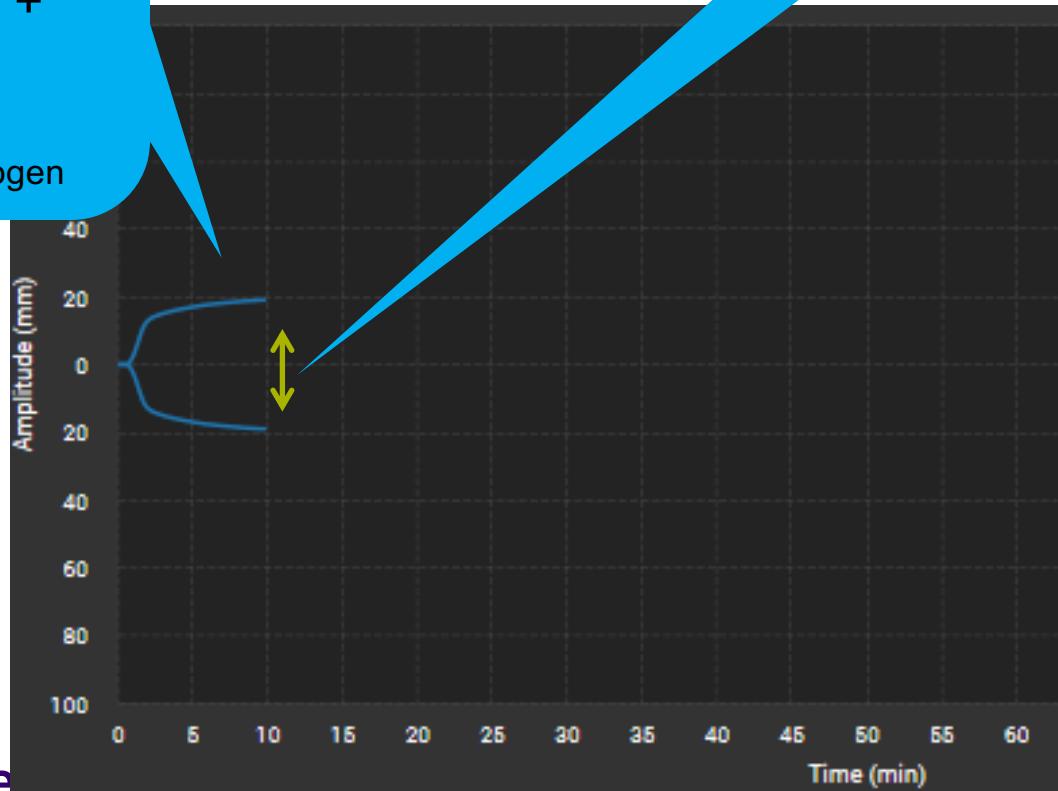
Clot Strength - MA

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Maximally Activated +
Platelet Inhibitor

Specific assessment of fibrinogen

MA - FIBRIN
Clot Strength



world class expertise

young carers

NHS

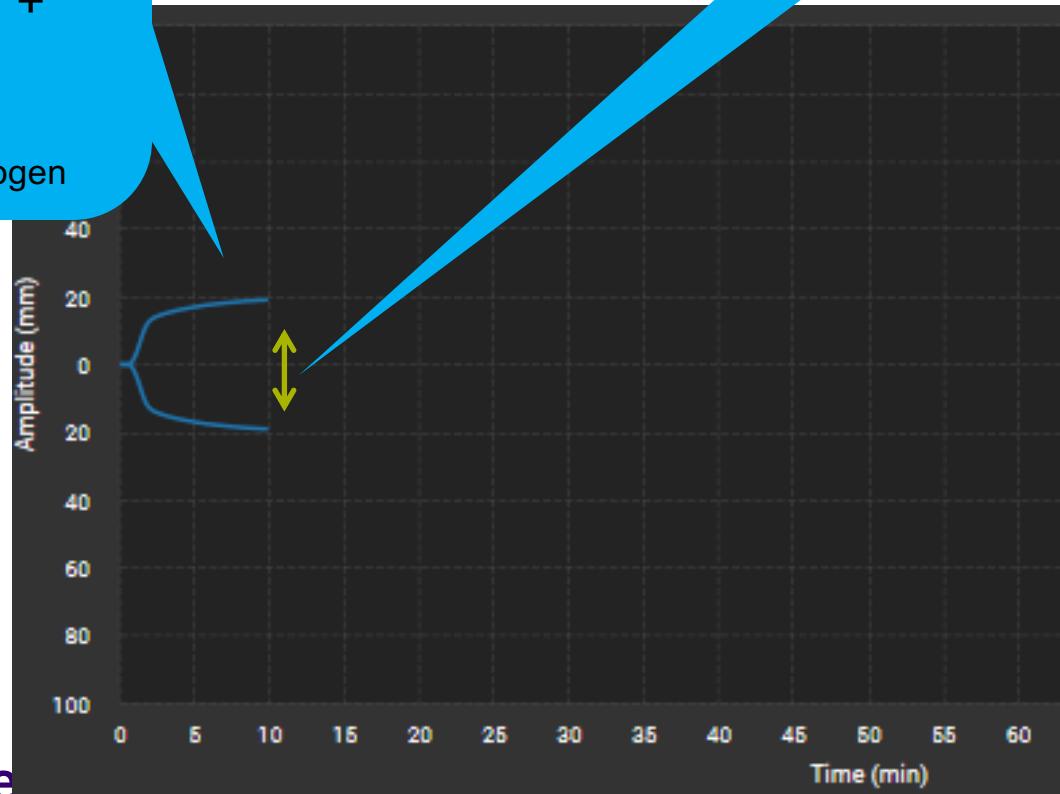
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MA - FIBRIN
Clot Strength

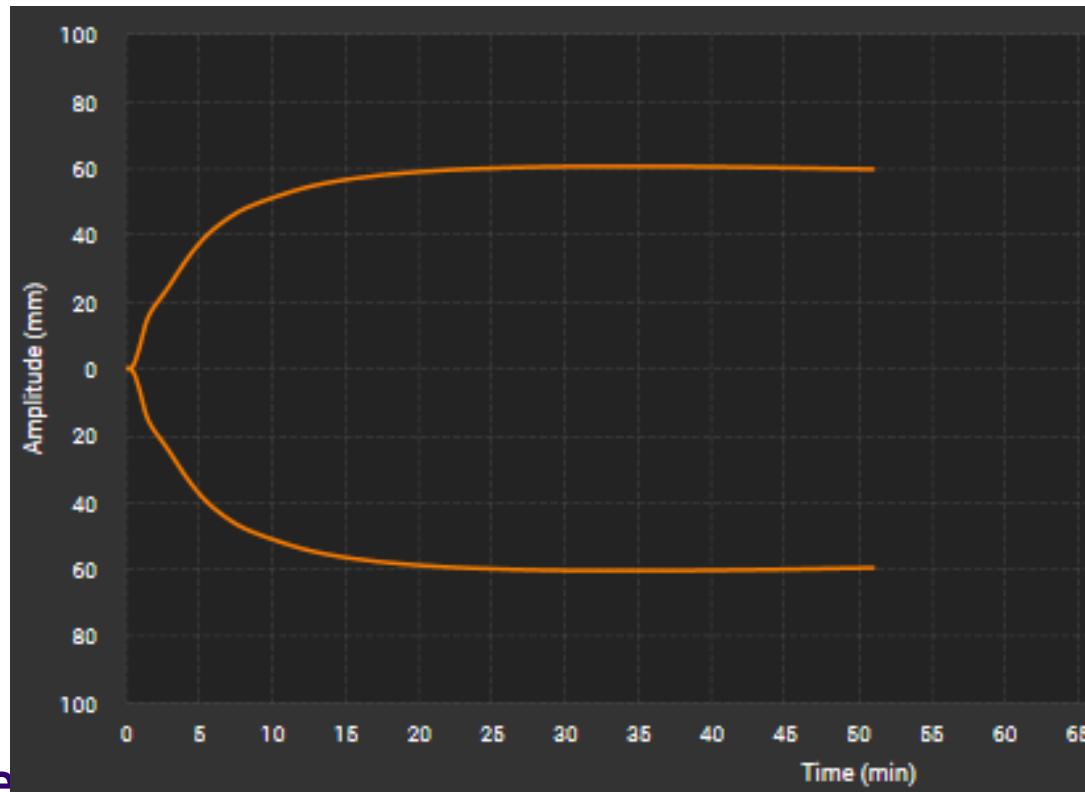


world class expertise

young carers

NHS

Clot Strength - MA



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young carers

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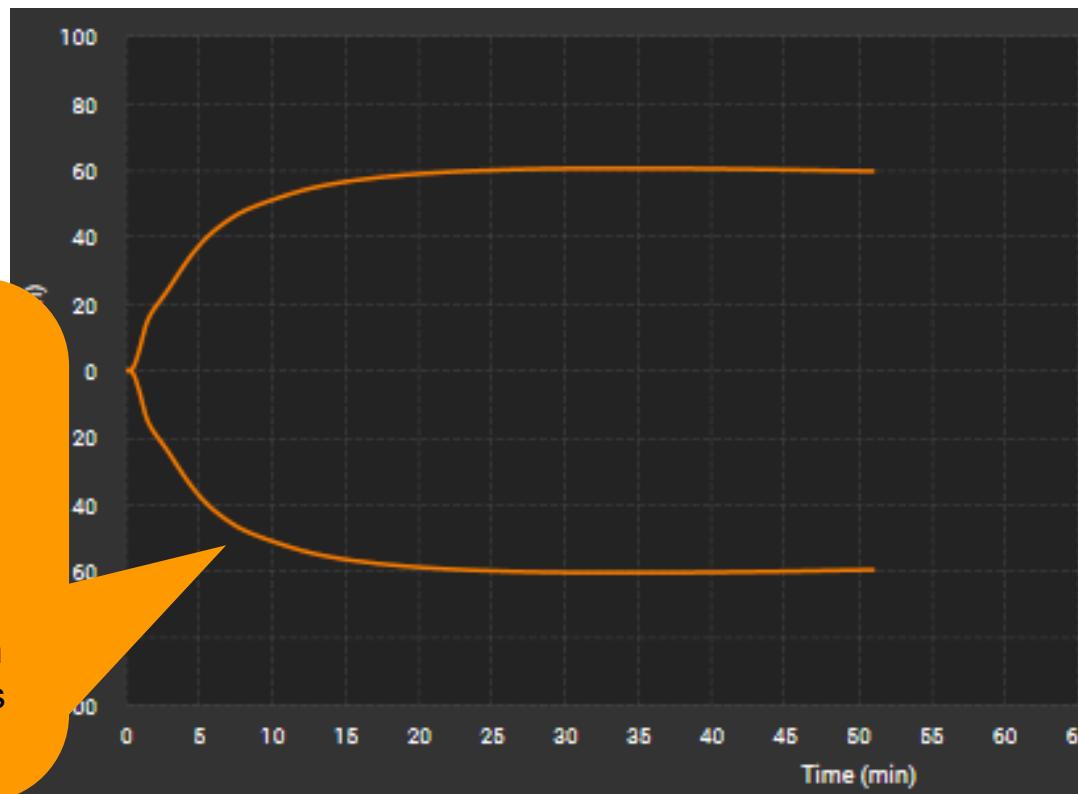
Clot Strength - MA

Rapid TEG®

(CRT)

Maximally activated

Rapid assessment of clot strength, used in combination with CFF to differentiate plt vs fib contribution



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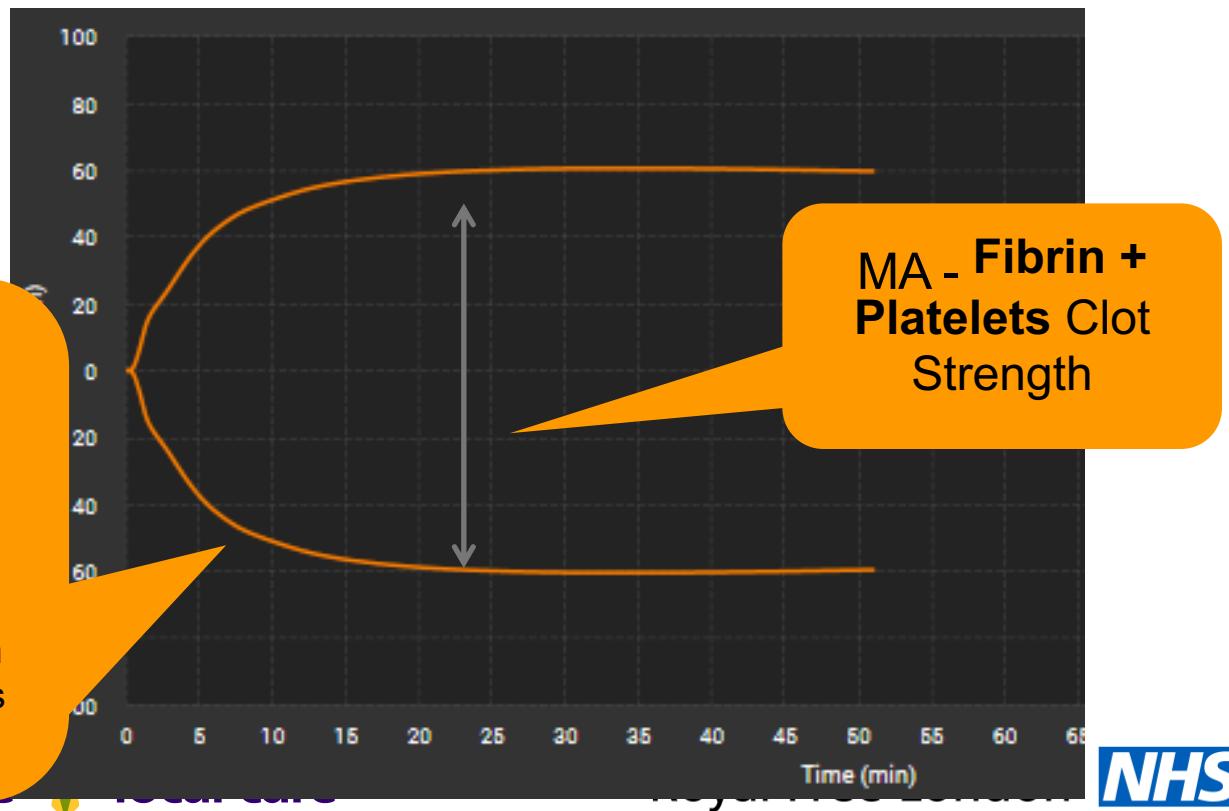
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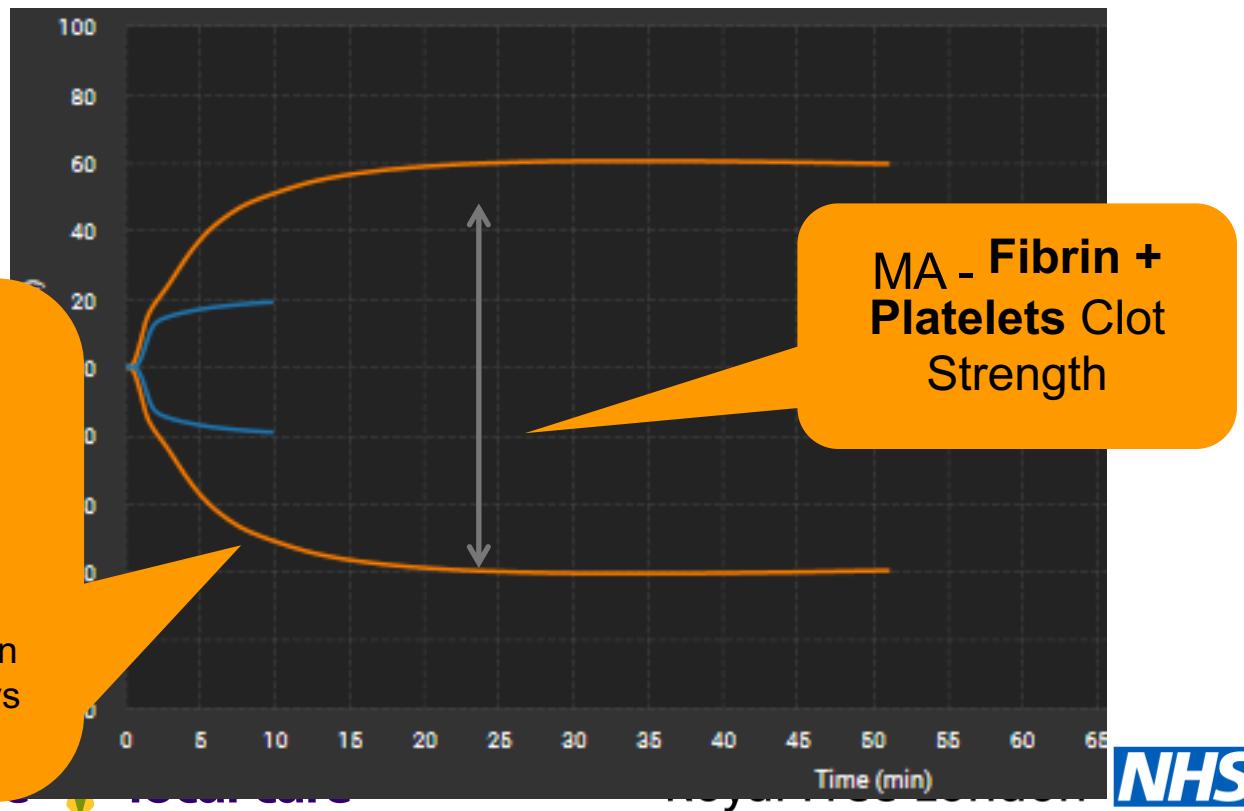
Clot Strength - MA

Rapid TEG®

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Maximally activated

Rapid assessment of clot strength, used in combination with CFF to differentiate plt vs fib contribution



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Clot Strength - MA

**Functional Fibrinogen®
(CFF)**

Maximally Activated +
Platelet Inhibitor

Specific assessment of fibrinogen

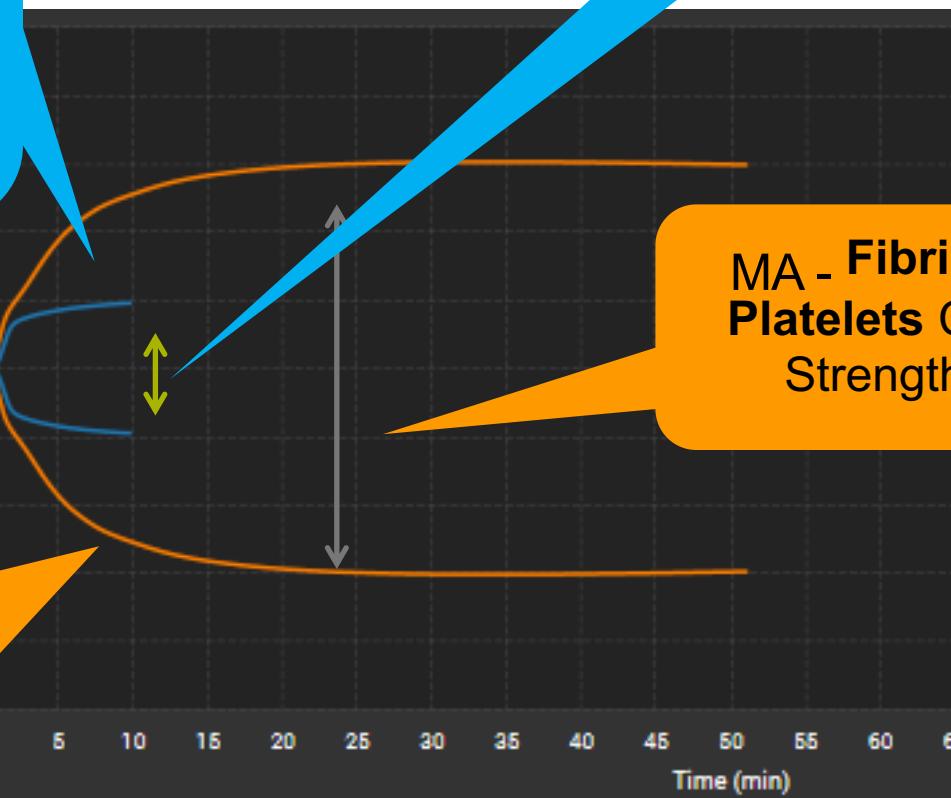
**Rapid TEG®
(CRT)**

Maximally activated

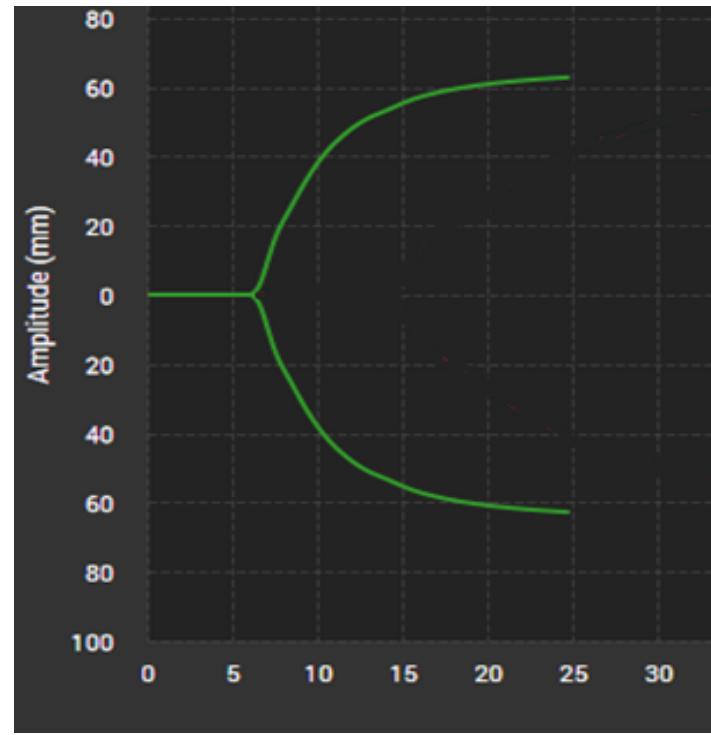
Rapid assessment of clot
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fib contribution

**MA - FIBRIN
Clot Strength**

**MA - Fibrin +
Platelets Clot
Strength**



Rate of Clot Formation - R



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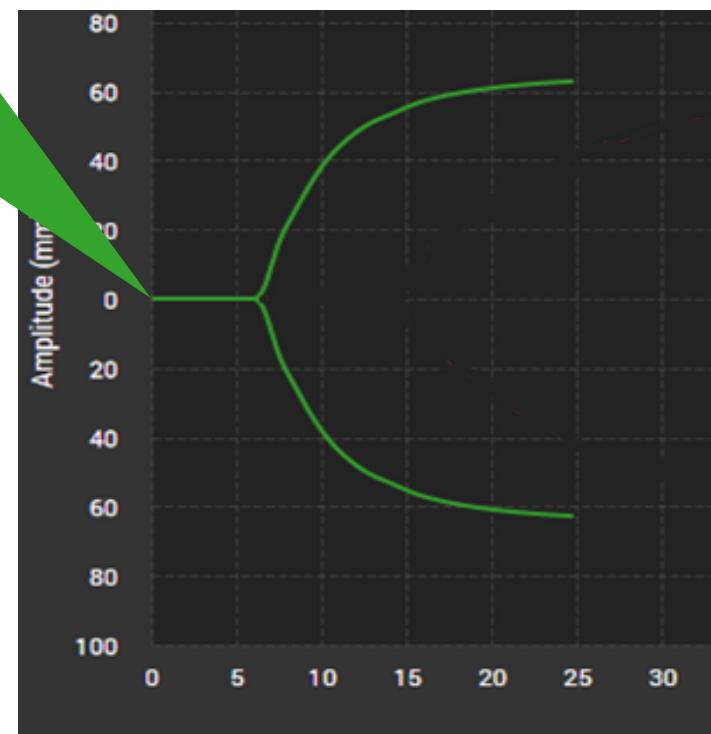
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Rate of Clot Formation - R

**Kaolin Heparinase
(CKH)**

Kaolin Activated +
Heparinase

Most sensitive assessment of
clotting factor competency



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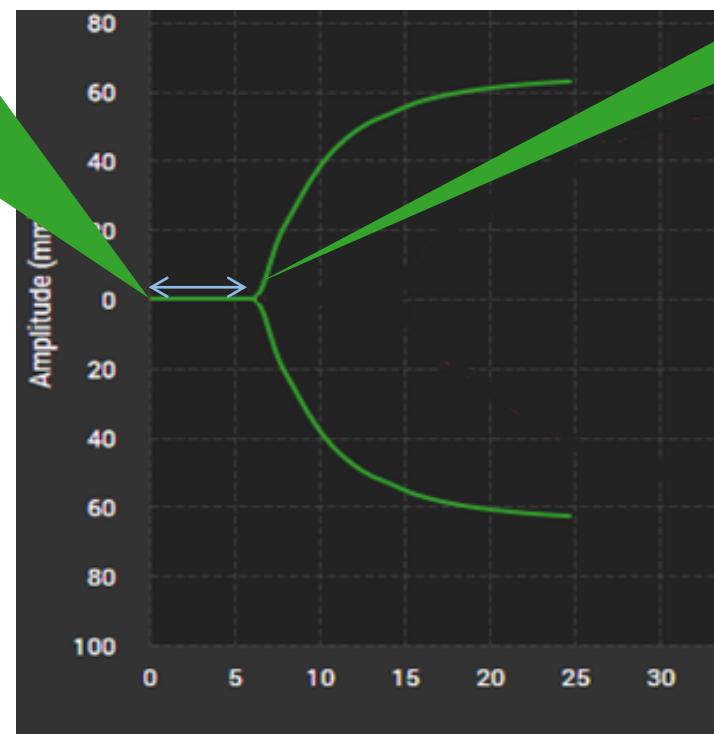
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Most sensitive assessment of
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R – Clotting
Factors



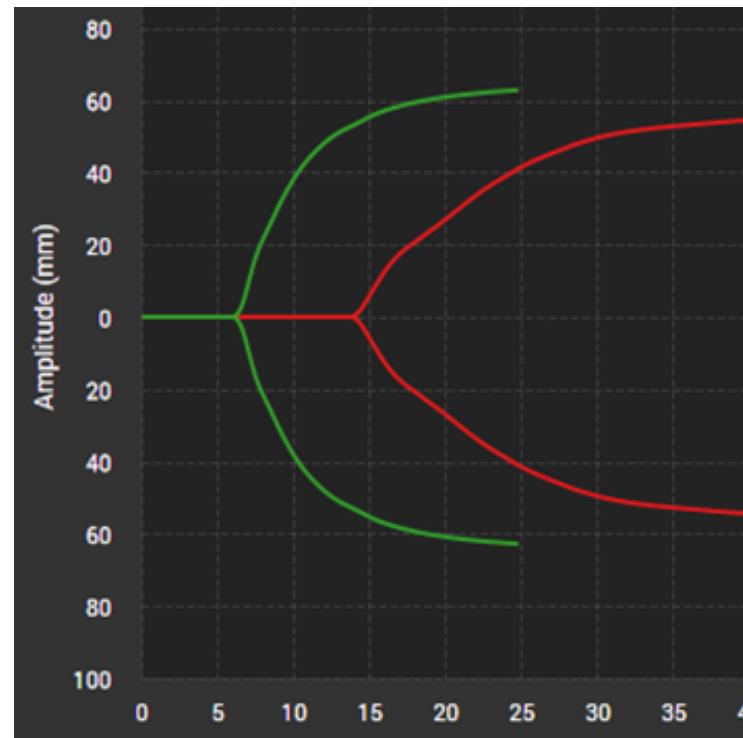
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Rate of Clot Formation - R



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Rate of Clot Formation - R

Kaolin
(CK)

Kaolin Activated

Used in combination with CKH.

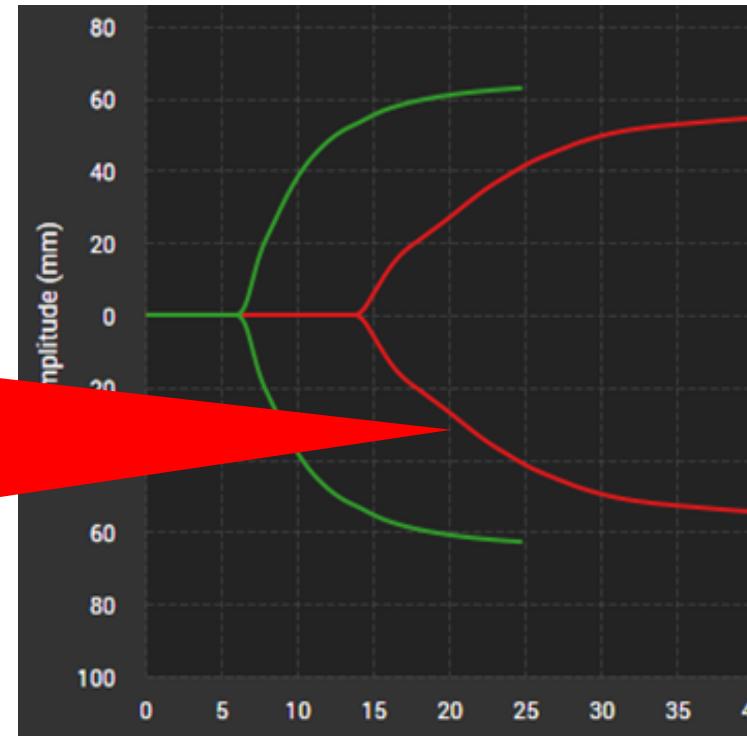
Specific Assessment of Heparin:

UFH, LMWH, end. hep



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Rate of Clot Formation - R

Kaolin
(CK)

Kaolin Activated

Used in combination with CKH.

Specific Assessment of Heparin:

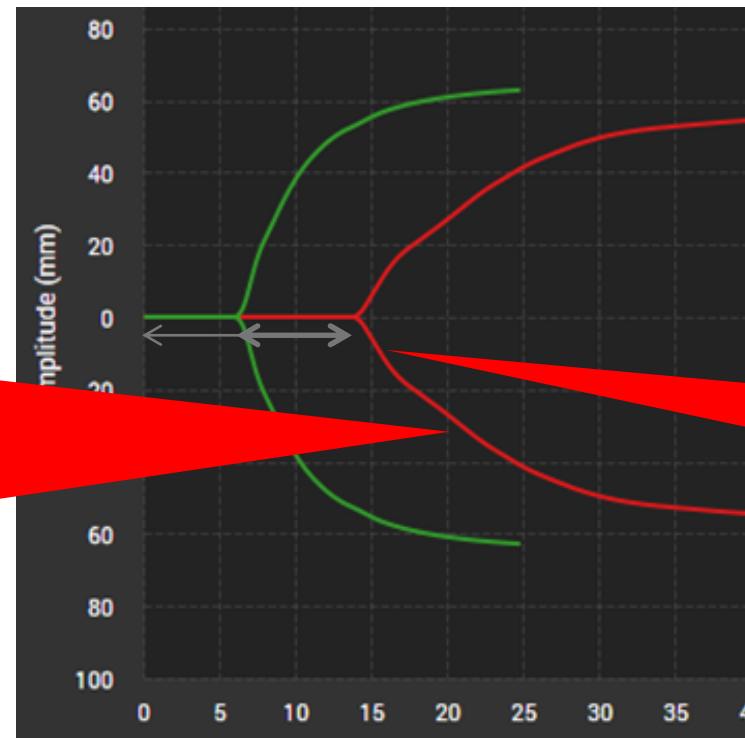
UFH, LMWH, end. hep



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R – Heparin effect

Rate of Clot Formation - R

**Kaolin Heparinase
(CKH)**

Kaolin Activated +
Heparinase

Most sensitive assessment of
clotting factor competency

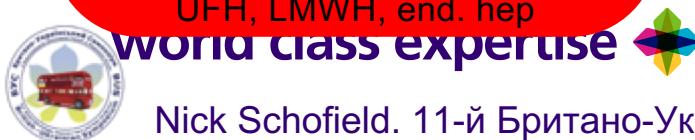
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Kaolin Activated

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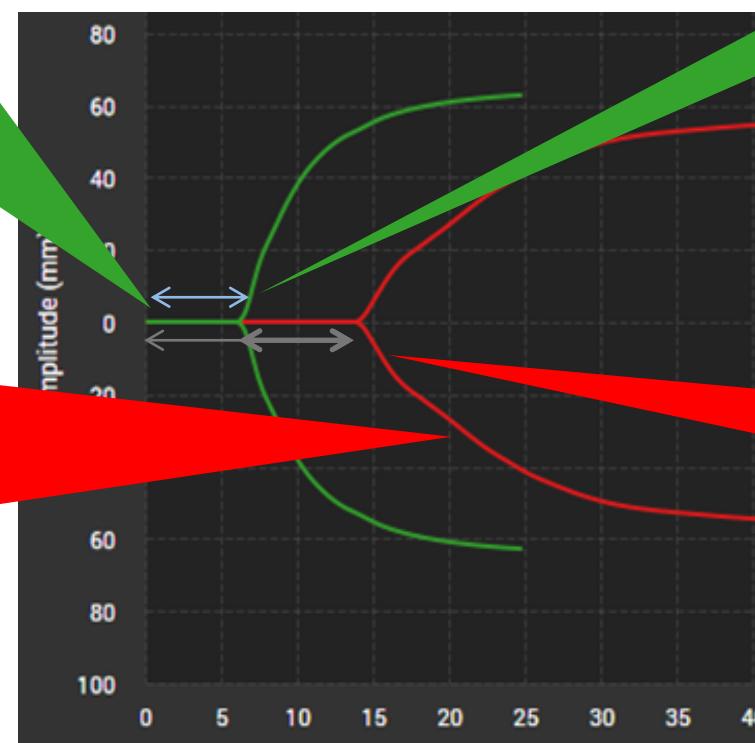
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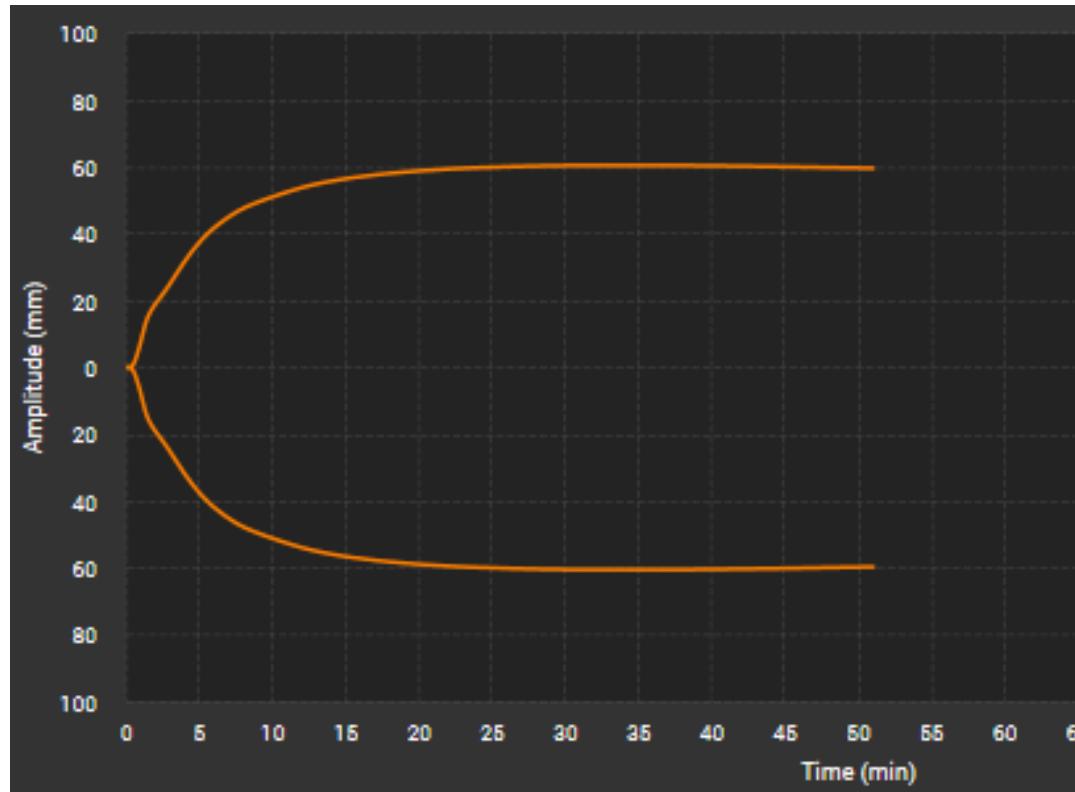


**R – Clotting
Factors**

**R – Heparin
effect**



Clot Stability



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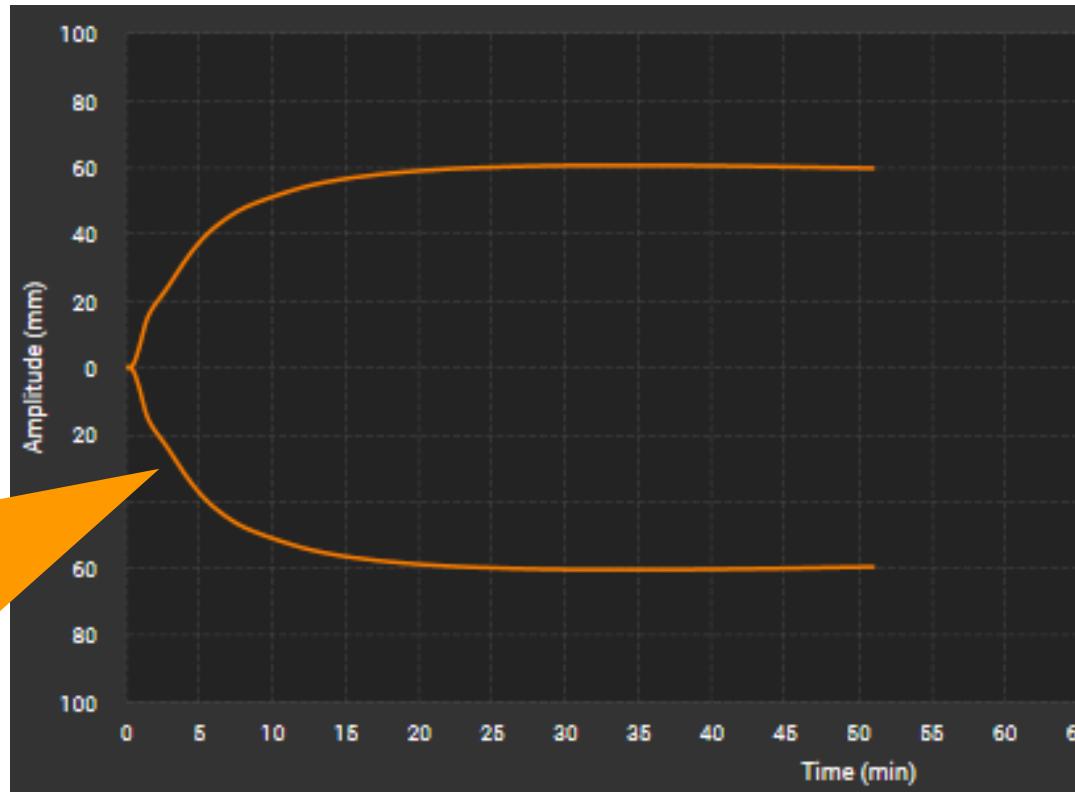
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Clot Stability

Rapid TEG ®
(CRT)

Maximally activated
Rapid assessment
of clot strength and
lysis



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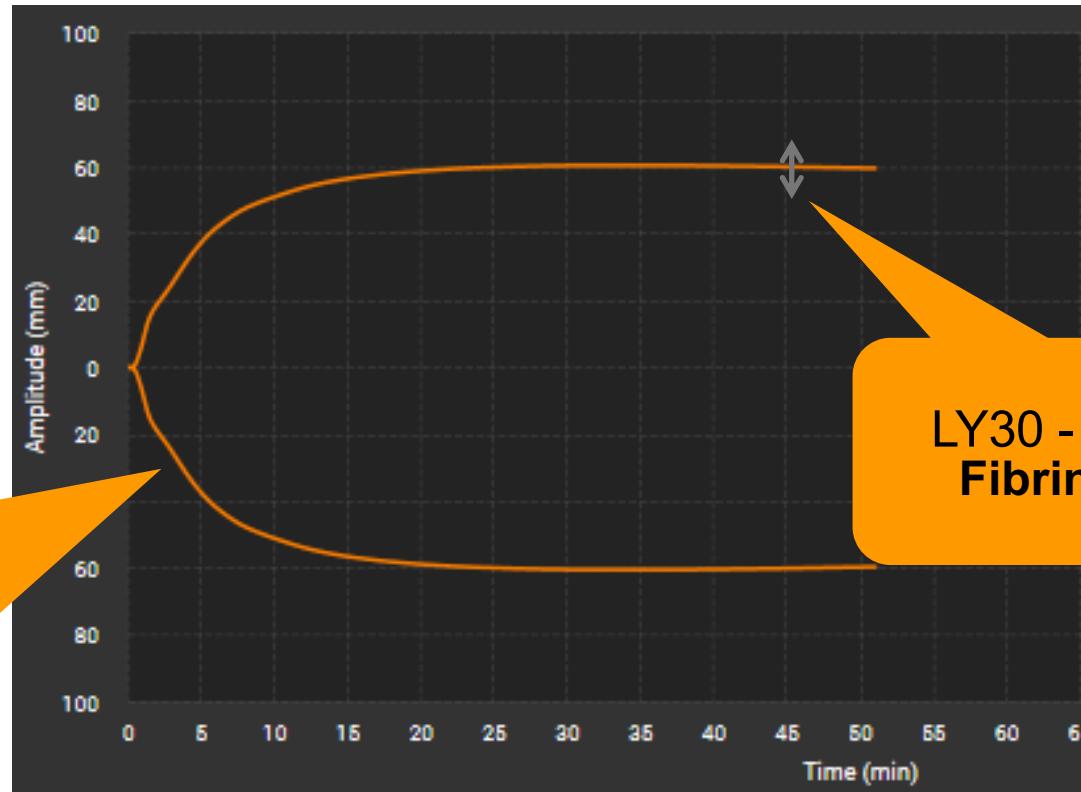
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Rapid assessment
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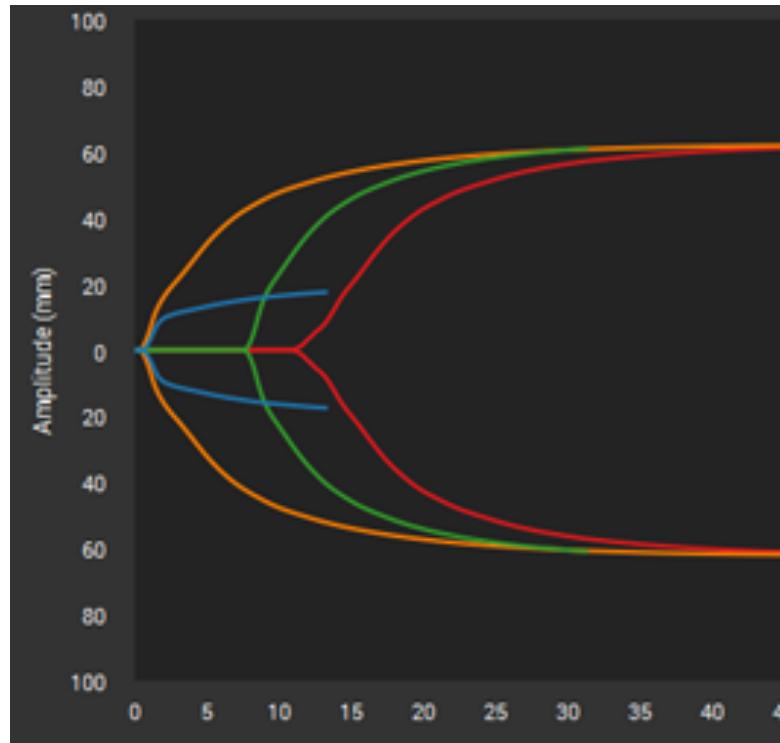
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Bringing it all together



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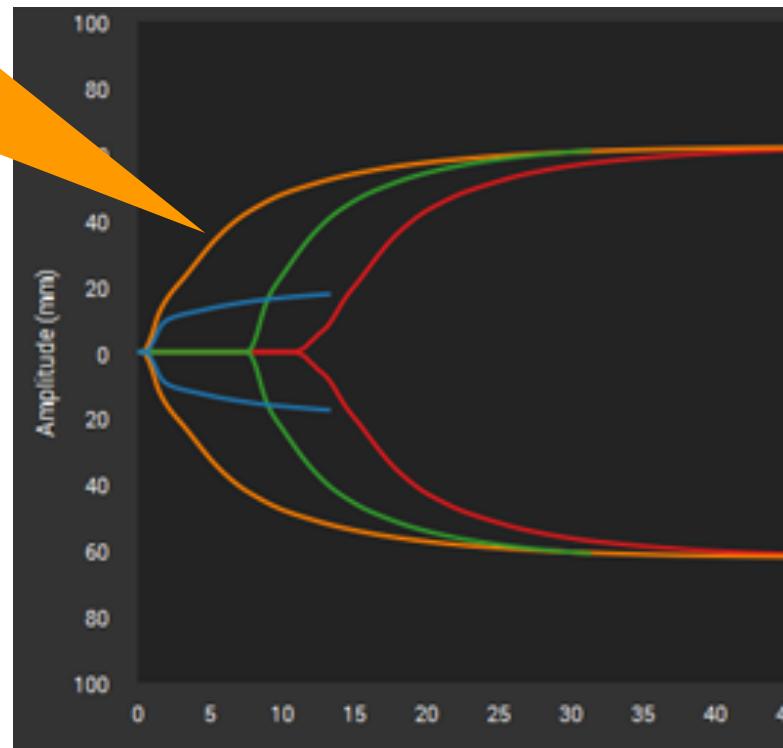
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Bringing it all together

Rapid TEG ®
(CRT)

MA - Platelets
LY-30 - Lysis



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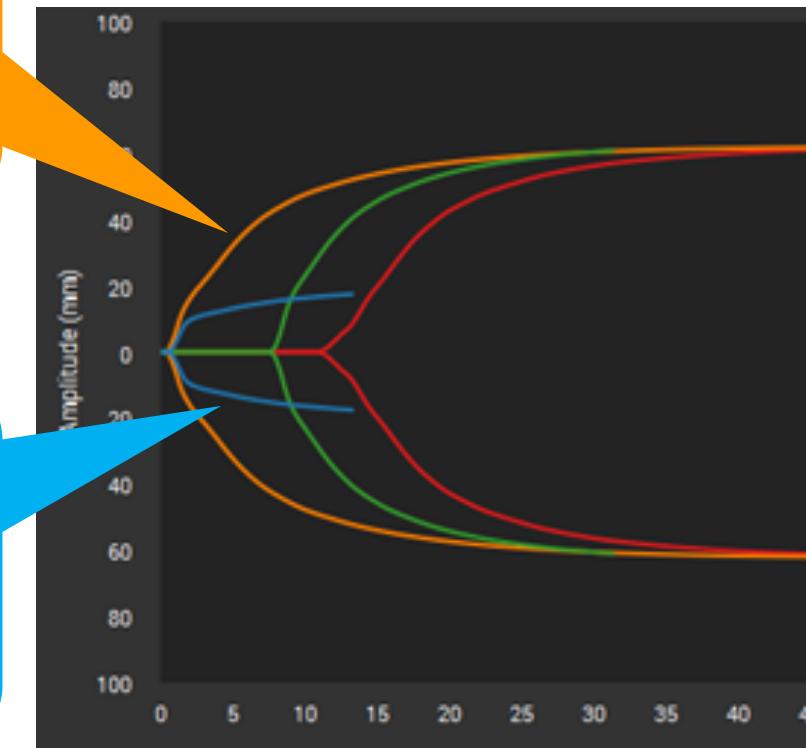
Bringing it all together

Rapid TEG ®
(CRT)

MA - Platelets
LY-30 - Lysis

Functional
Fibrinogen®
(CFF)

MA - Fibrinogen



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Bringing it all together

Rapid TEG ®
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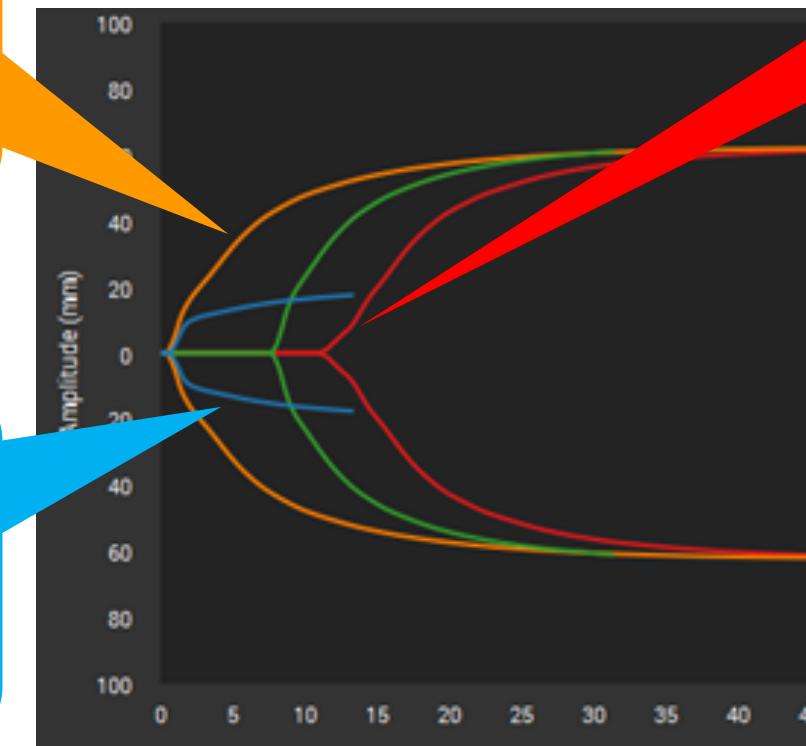
MA - Platelets
LY-30 - Lysis

Functional
Fibrinogen®
(CFF)

MA - Fibrinogen

Kaolin
(CK)

R – Heparin



Bringing it all together

Rapid TEG ®
(CRT)

MA - Platelets
LY-30 - Lysis

Functional
Fibrinogen®
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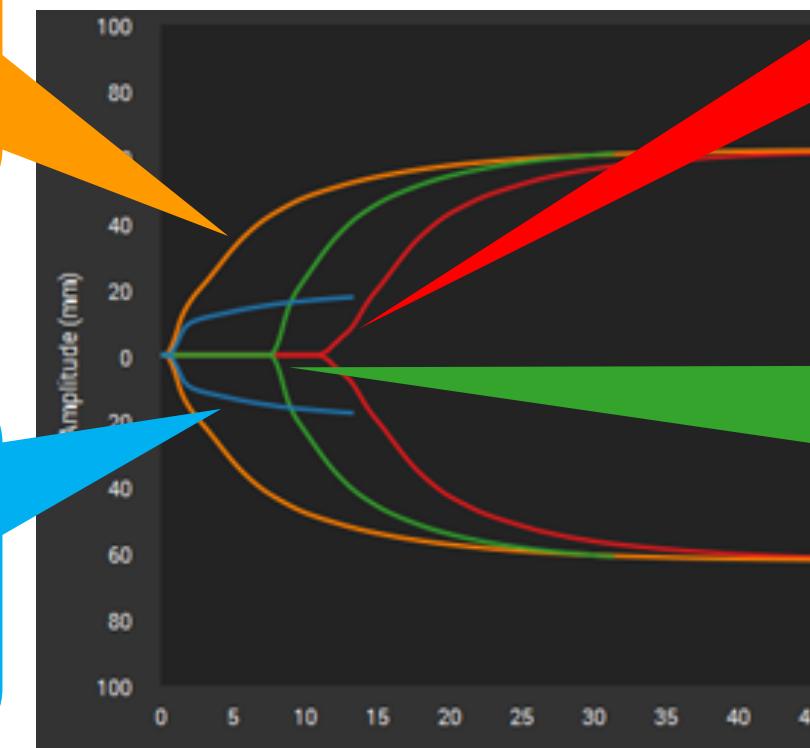
MA - Fibrinogen

Kaolin
(CK)

R – Heparin

Kaolin
Heparinase
(CKH)

R – Clotting Factors

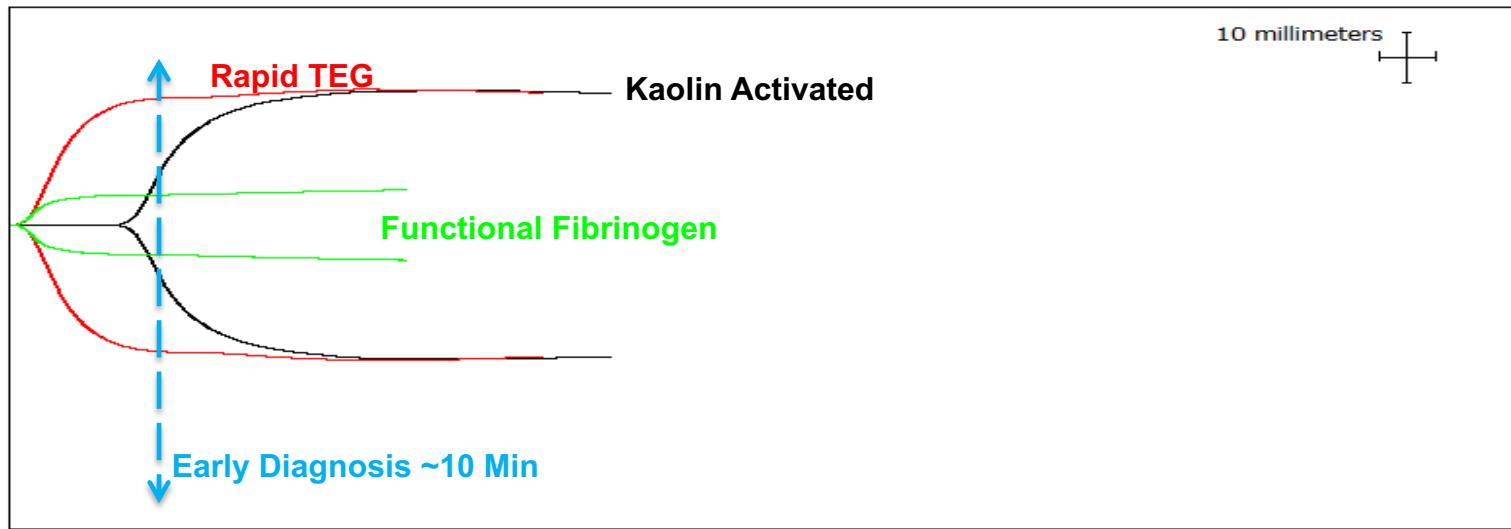


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TEG 6s – Timely



The TEG 6s is designed to offer rapid results for faster clinical decision-making:

In ~ 10 minutes

In ~ 40 minutes

R | Kaolin

LY30 | RapidTEG

MA | RapidTEG

MA | Functional Fibrinogen

ΔR | Difference between Kaolin vs.
Kaolin Heparinase



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TEG6s System



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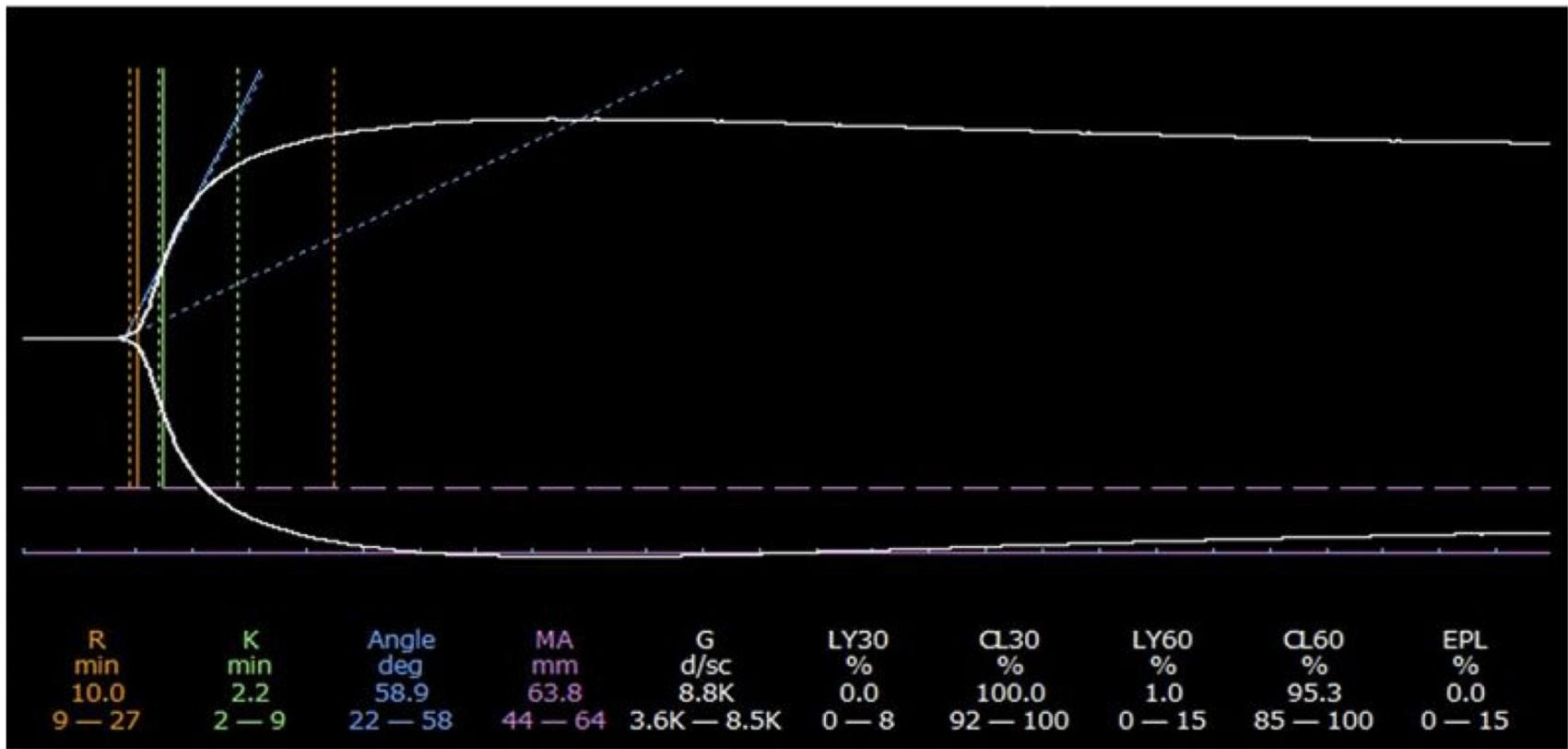
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Stage	Parameter	Problem	Product required
Initiation	R time	Clotting factors	FFP
Propagation	K time, α angle	Multiple Eg Massive haemorrhage/Dilution	Factor concentrates (PCC) Fibrinogen Platelets
Strength	MA	Fibrinogen Platelets	Cryoprecipitate Fibrinogen concentrate Pool platelets
Stability	Lysis time 30 (%)	Hyperfibrinolysis	Tranexamic acid



Normal trace



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Clotting factor deficiency



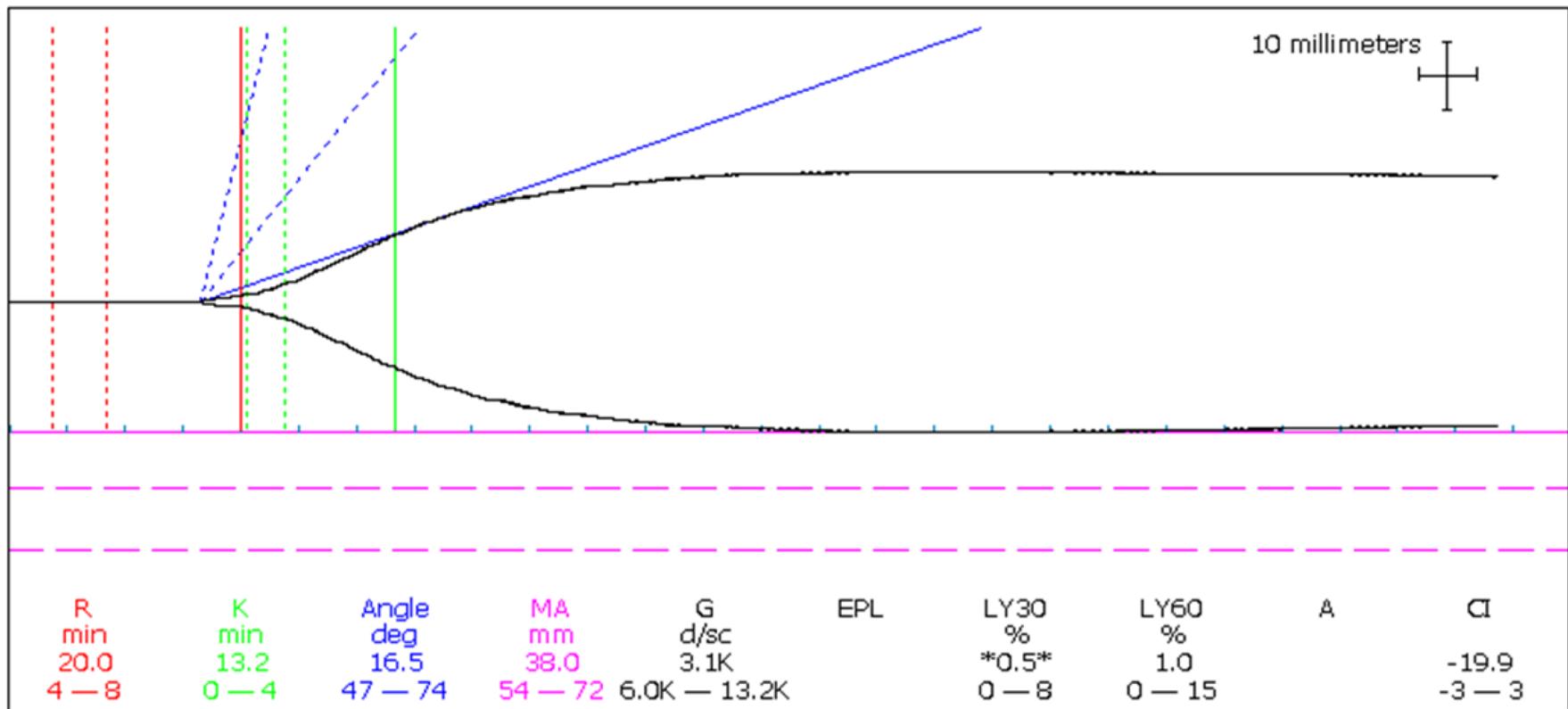
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(factor deficiency)

Sample: 07/07/1998 07:42-09:51

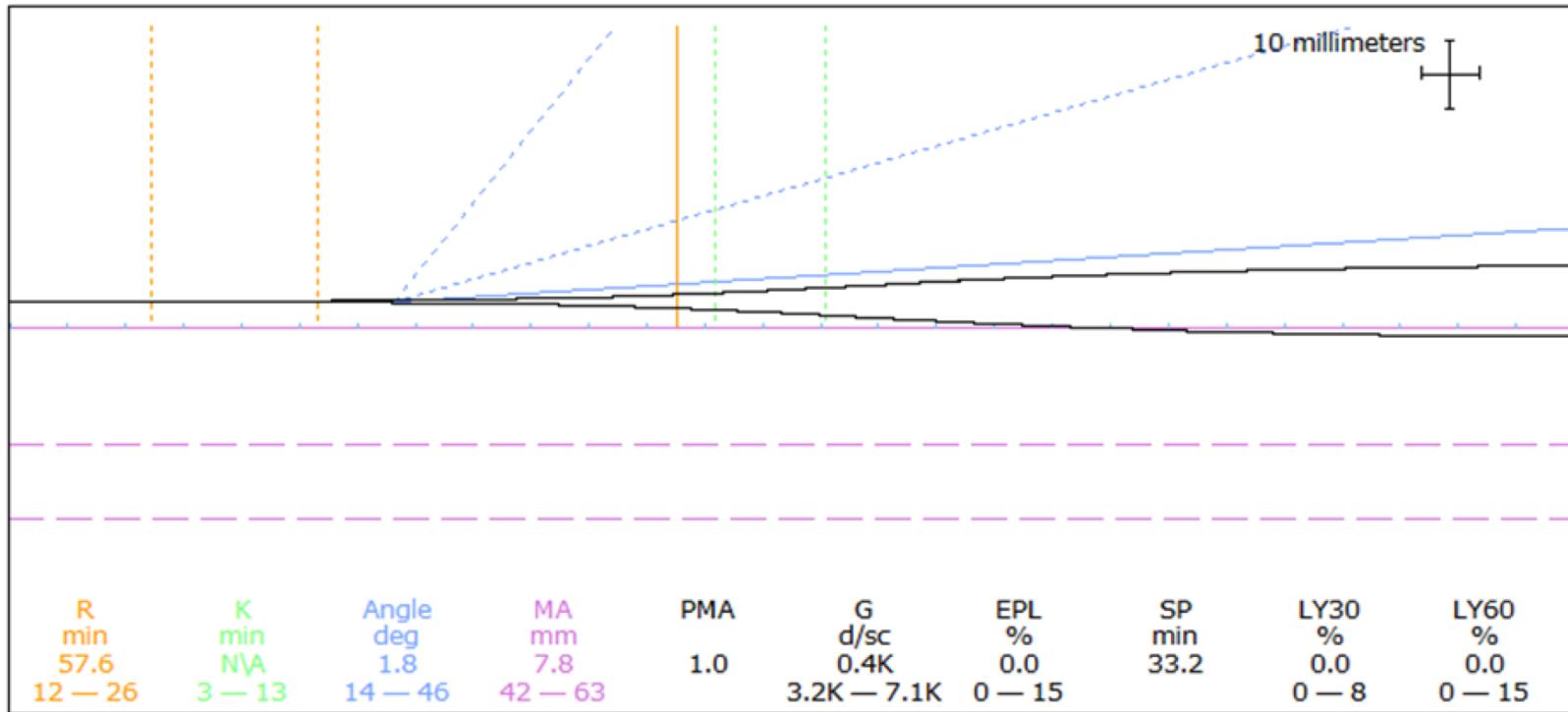


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Low clot strength (Fibrinogen)

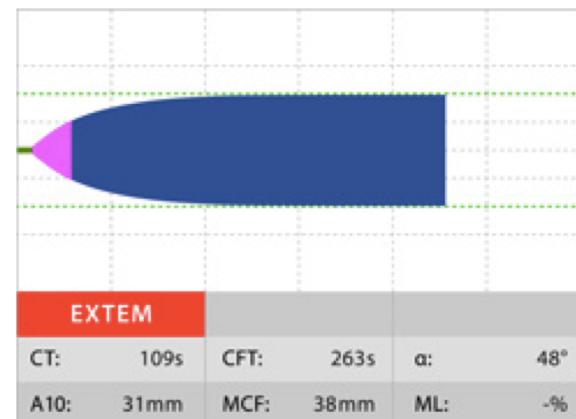
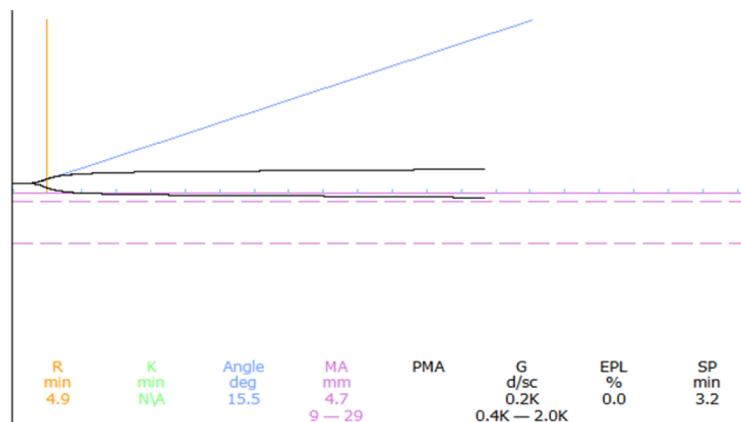
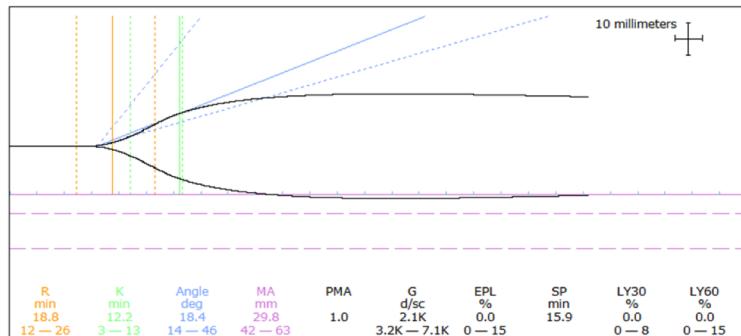


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dissection 2 8 Native with heparinase
Sample: 09/03/2015 10:07AM-11:53AM



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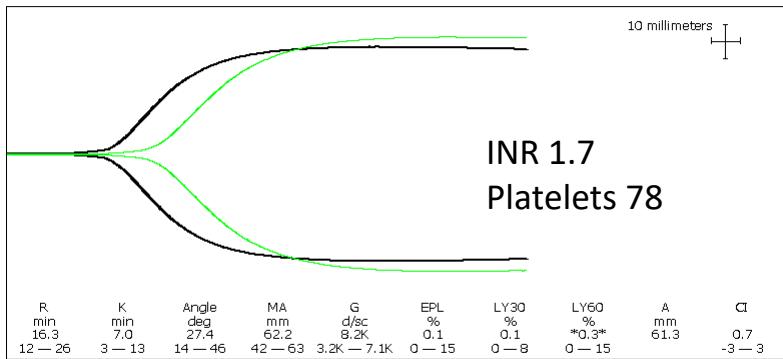
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Baseline

1 Native

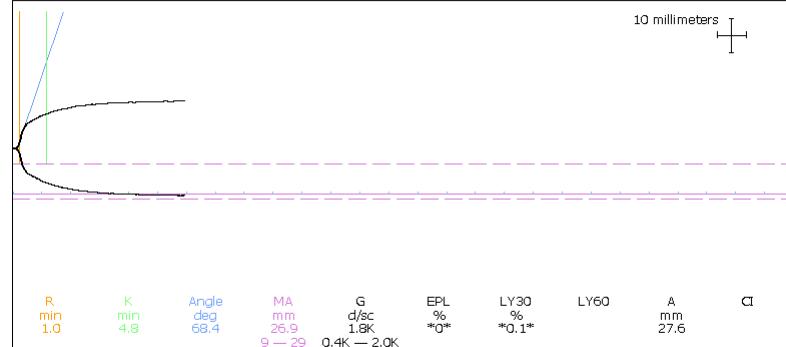
Sample: 24/10/2008 12:10PM-01:40PM



FLEV = 4.9 g/l

7 Functional fibrinogen level

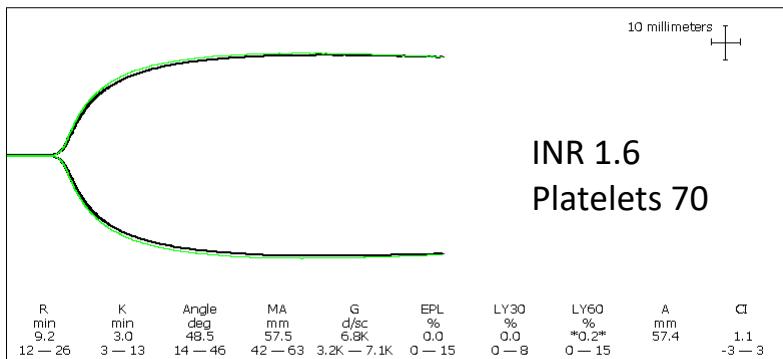
Sample: 24/10/2008 12:21PM-12:50PM



Dissection 1

5 Native

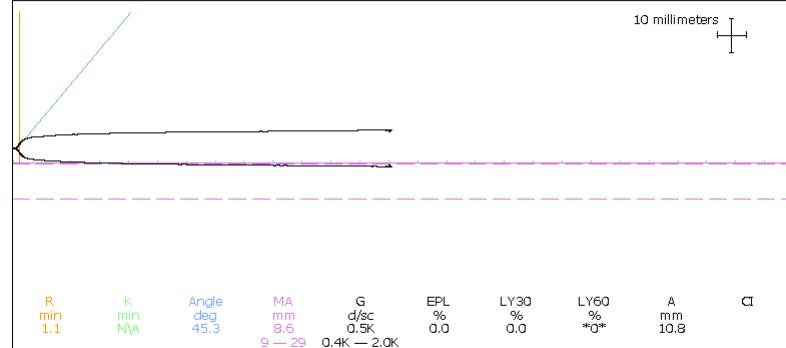
Sample: 07/11/2008 08:37AM-09:53AM



FLEV = 1.6 g/l

3 Functional fibrinogen level

Sample: 07/11/2008 07:33AM-08:39AM



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Low clot strength (Platelets)



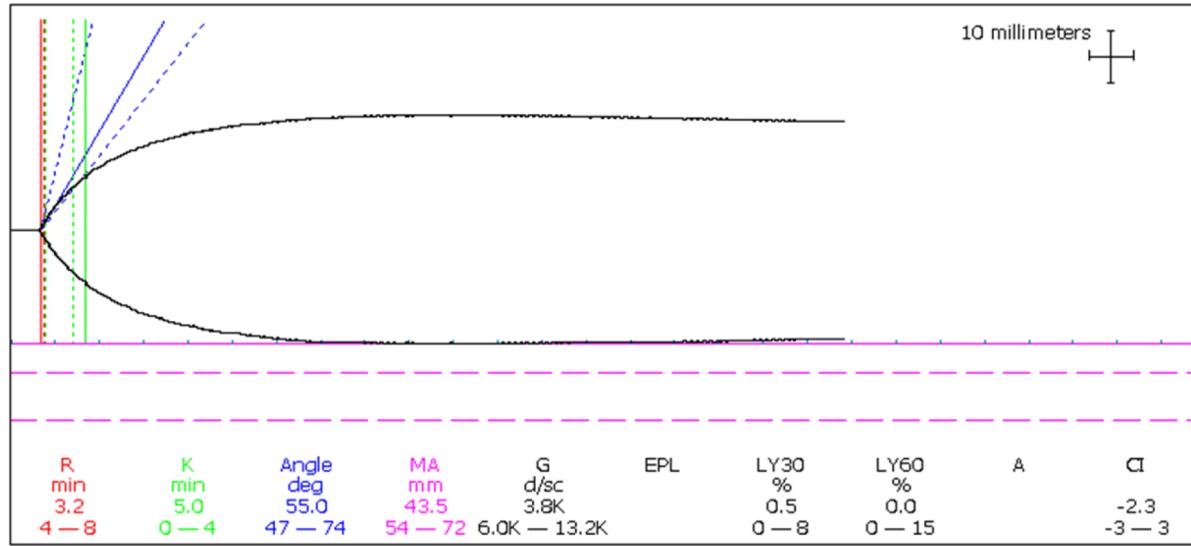
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(platelet dysfunction)

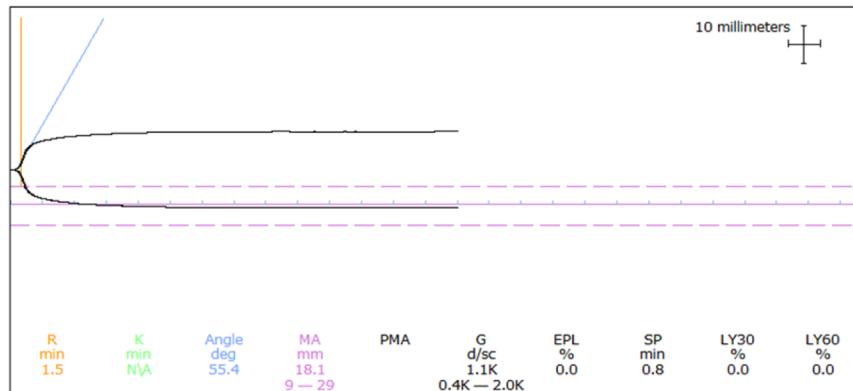
Sample: 01/07/1998 10:39-12:13



FLEV = 3.3 g/l

3 Functional fibrinogen level with heparinase

Sample: 30/03/2015 07:49PM-08:59PM

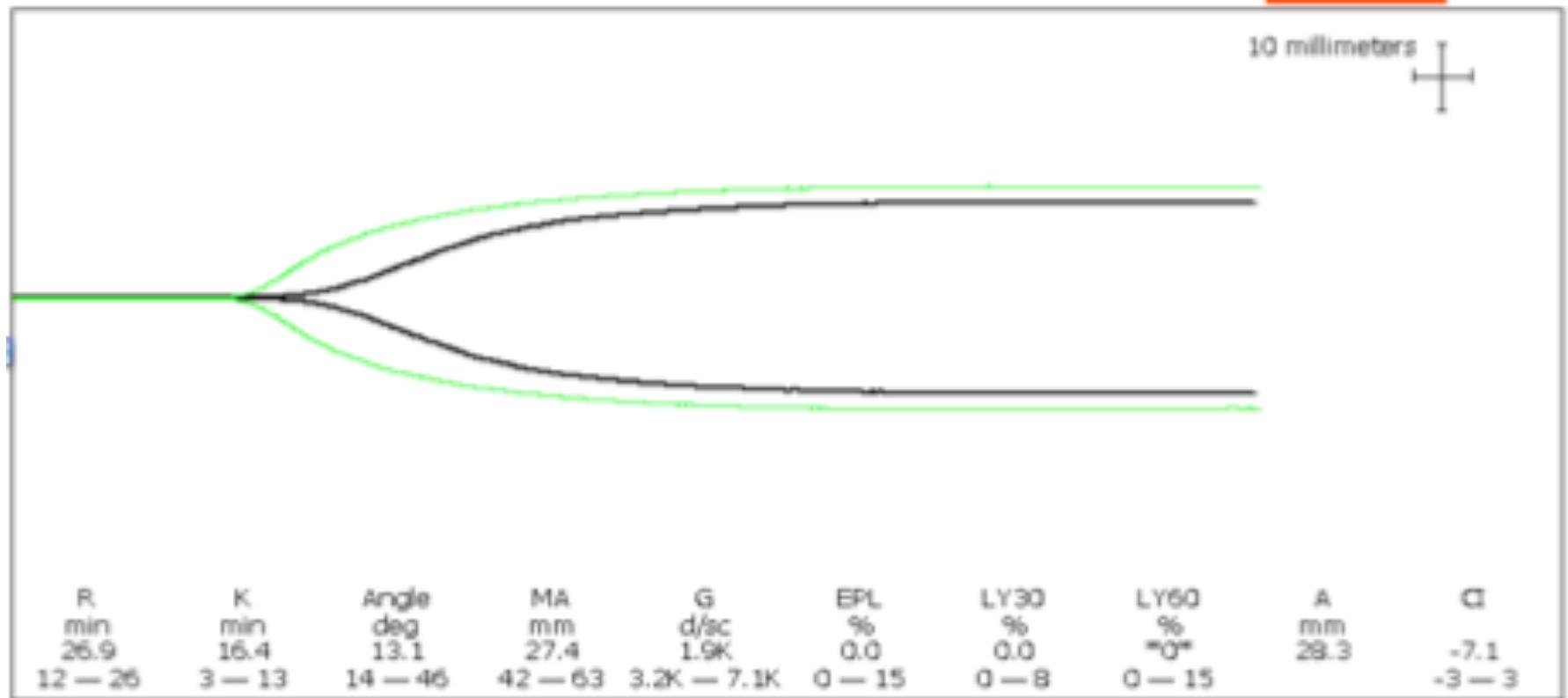


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Lysis (Tranexamic acid)



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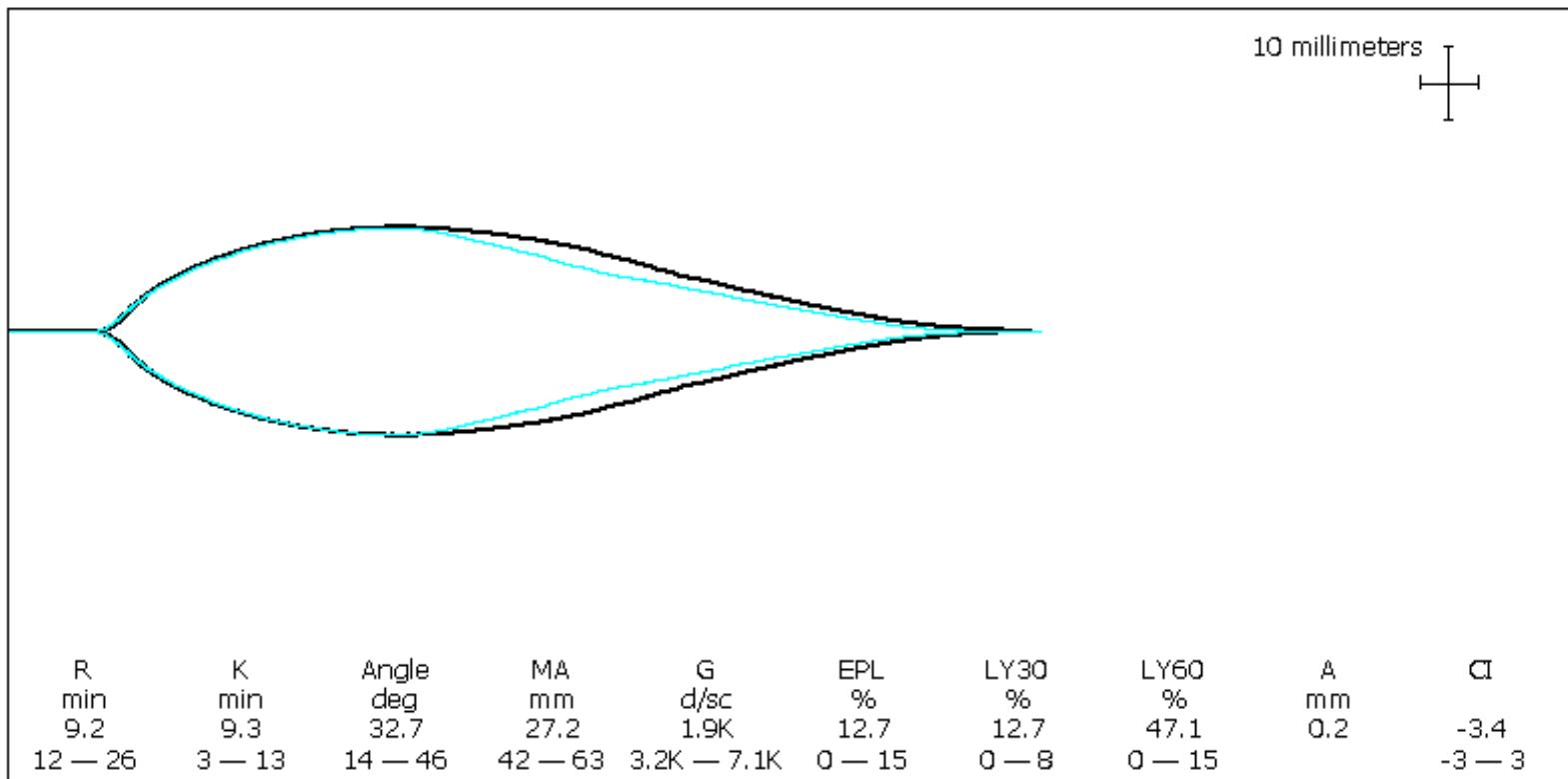
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anhepatic 2

1 Native

Sample: 21/05/2011 17:38-19:07



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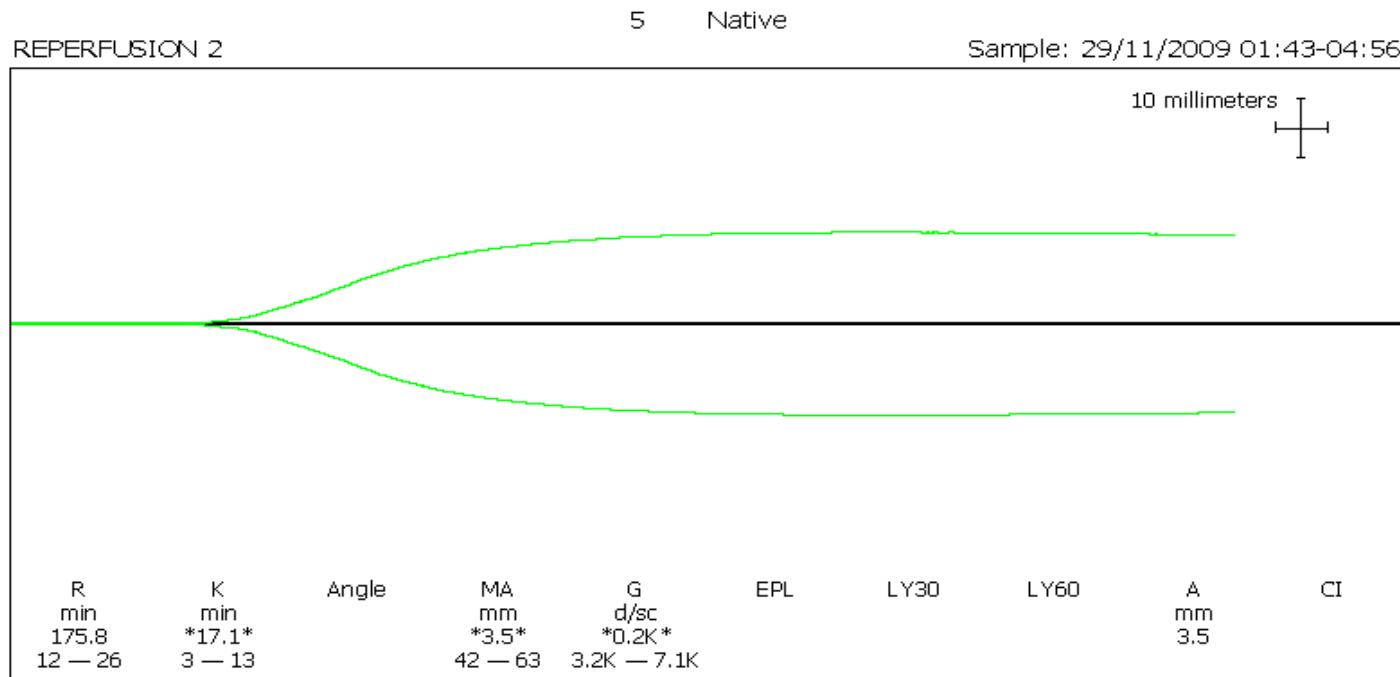
Heparin Effect



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Summary

Point of care testing

Quick

Real time

Analysis of the whole clot

Allows timely appropriate transfusion of blood products



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<https://youtu.be/aW6t9gnGnyE>



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