

VISCOELASTIC TESTING IN THE OPERATING ROOM

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DISCLOSURE

- I am a paid consultant for Cerus Corporation

WHAT IS VISCOELASTIC TESTING?

- Viscoelastic testing is a whole-blood test that provides real-time assessment of clot formation, clot firmness, and clot breakdown
- Used in the operating room during
 - Cardiac surgery Liver transplantation Trauma surgery Obstetric surgery
- 4 major analyzers on the market

Rotational Thromboelastometry (ROTEM)



ROTEM SIGMA



ROTEM DELTA

Thromboelastography (TEG)



TEG 6s



TEG 5000

WHY USE VISCOELASTIC TESTING?

- Provides coagulation results **within minutes**
- Assesses the **entire clotting process** (initiation, propagation, clot strength, and fibrinolysis) at once
- Identifies specific **hemostatic deficits** to guide targeted therapy (fibrinogen, platelets, clotting factors, fibrinolysis)
- Associated with **lower transfusion requirements** and improved bleeding management in high-risk surgical populations

[Intervention Review]

Thromboelastography (TEG) or thromboelastometry (ROTEM) to monitor haemostatic treatment versus usual care in adults or children with bleeding

2026

Kvisselgaard AD, Wolthers SA, Wikkelsø AJ, Holst LB, Drivenes B, Afshari A

- 35 RCTs, 3096 participants
- Mostly cardiac surgery (smaller mix of trauma, postpartum hemorrhage, transplantation)
- Product reduction with viscoelastic testing use:
 - **Fresh frozen plasma:** reduced
 - **Platelets:** reduced
 - **Packed red blood cells:** no significant difference
 - (**Cryo:** not included)
- **Bleeding volume:** reduced

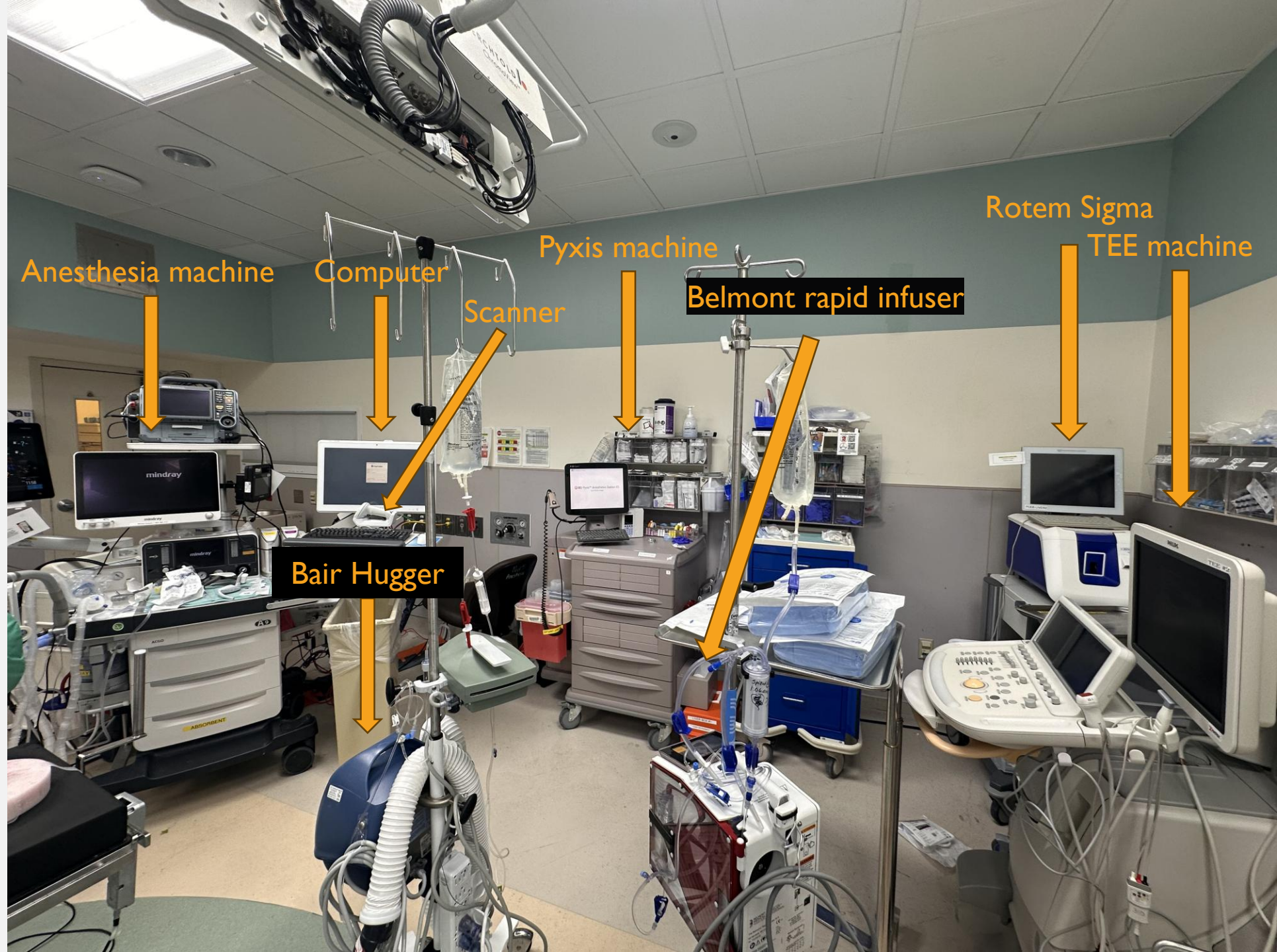
VISCOELASTIC TESTING VS CONVENTIONAL LABORATORY TESTING

Domain	VET	Conventional Laboratory Testing
Turnaround Time	Available within minutes at the point of care	Variable
Assessment of Clot Strength	Direct measurement of clot firmness and stability over time	Clot strength not directly assessed
Detection of Hyperfibrinolysis	Readily identified	Difficult to detect

THE ROTEM SIGMA SYSTEM

- Released in July 2022
- Produced by Werfen (Bedford, Massachusetts)
- FDA approved for use in **liver transplantation** and **cardiac surgery**
- (Also used in OB and trauma surgery)





Anesthesia machine

Computer

Pyxis machine

Scanner

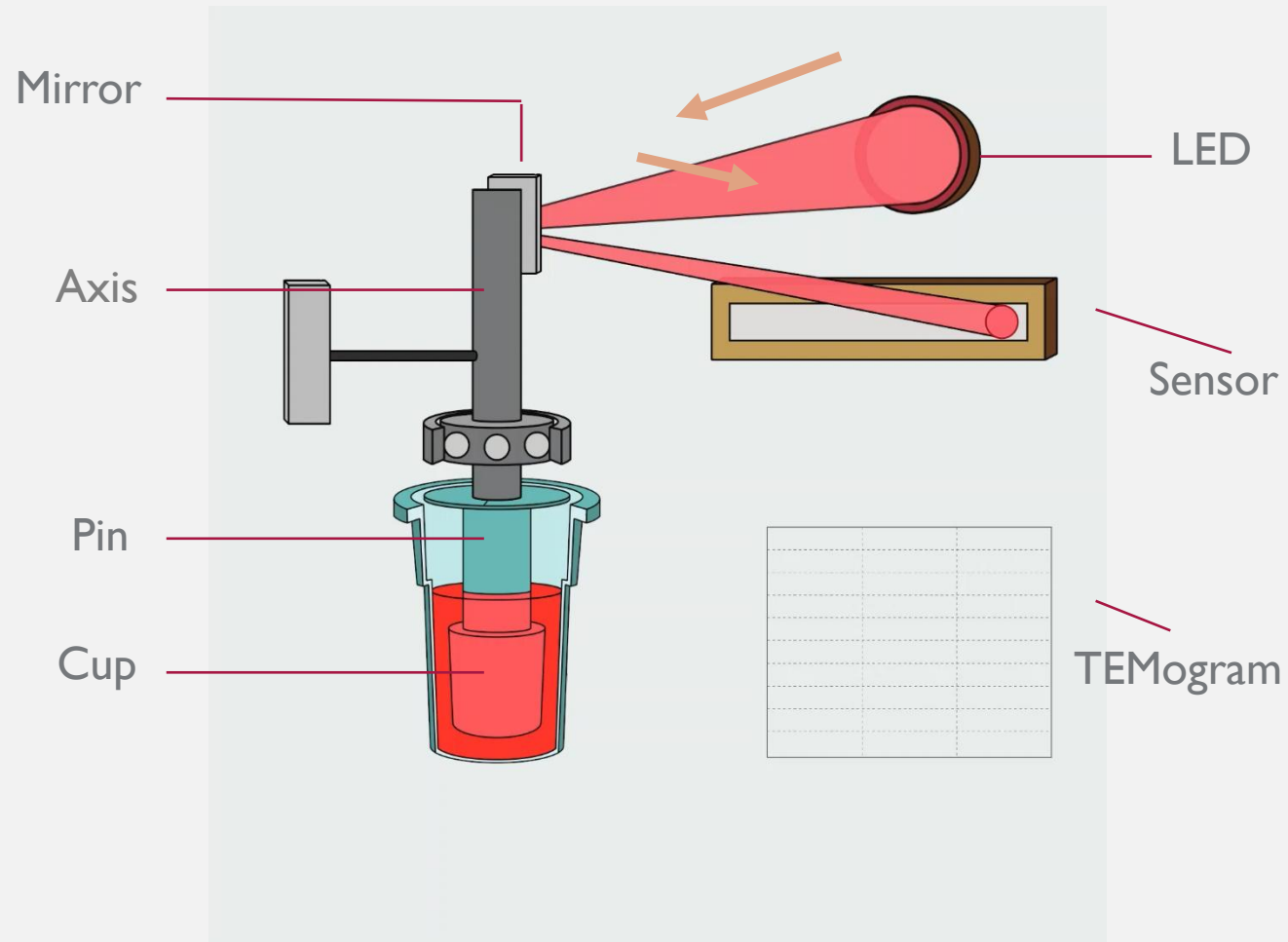
Belmont rapid infuser

Rotem Sigma

TEE machine

Bair Hugger

MEASUREMENT PRINCIPLE



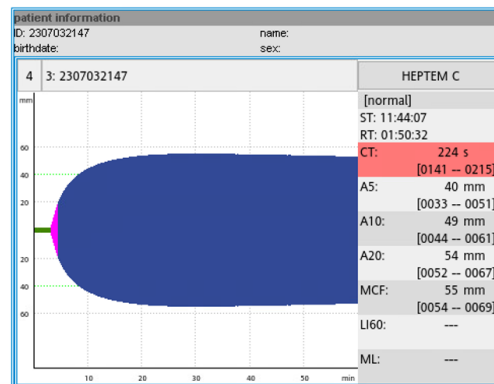
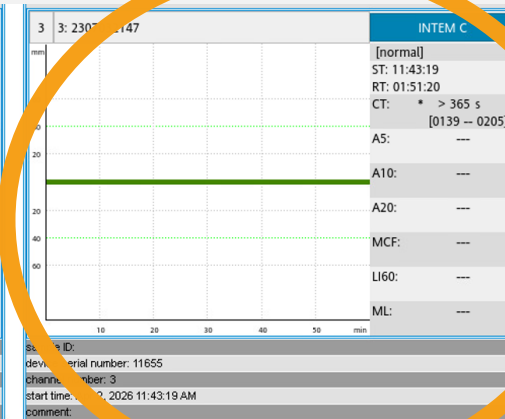
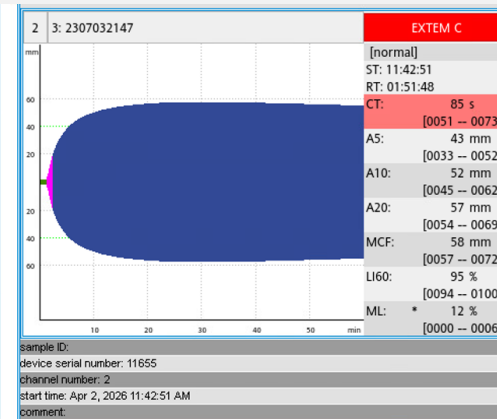
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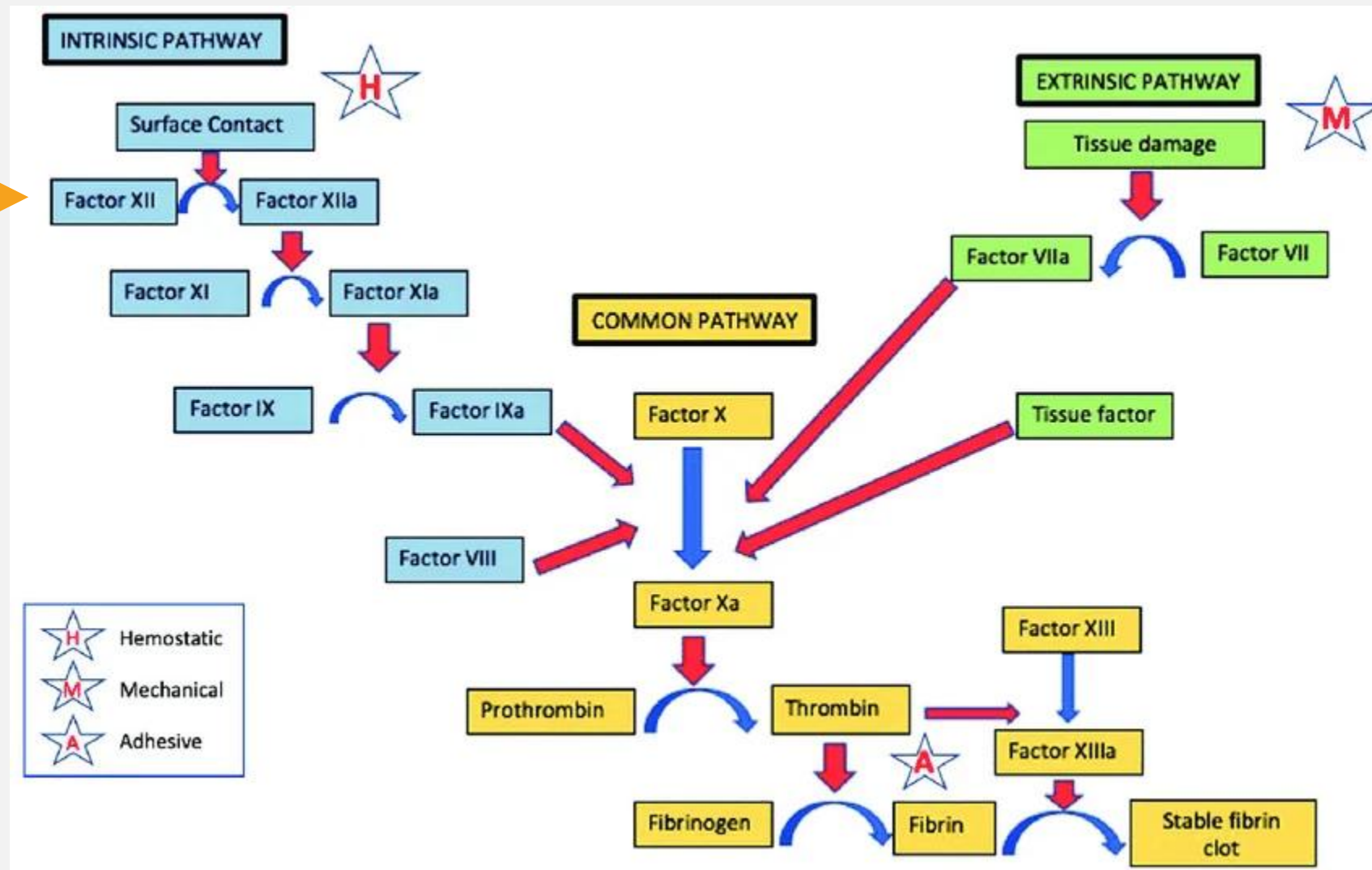
ROTEM *SIGMA* ASSAYS

- Four reagents/assays are available
 - INTEM C
 - HEPTTEM C
 - EXTEM C
 - FIBTEM C

INTEM C

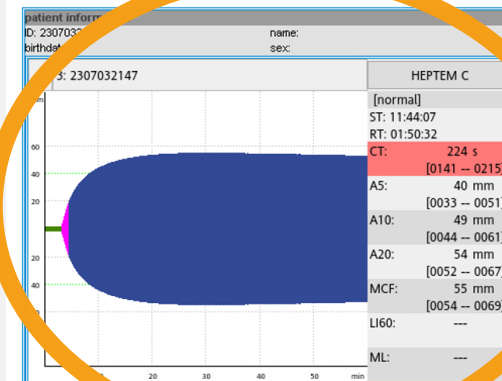
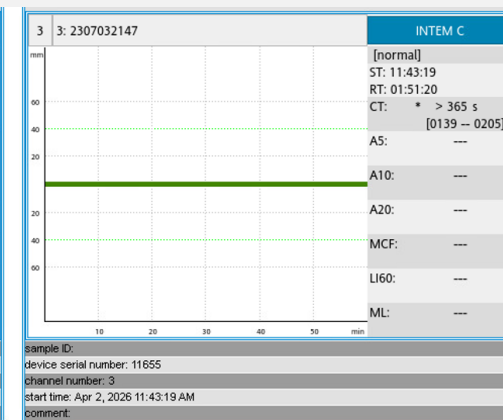
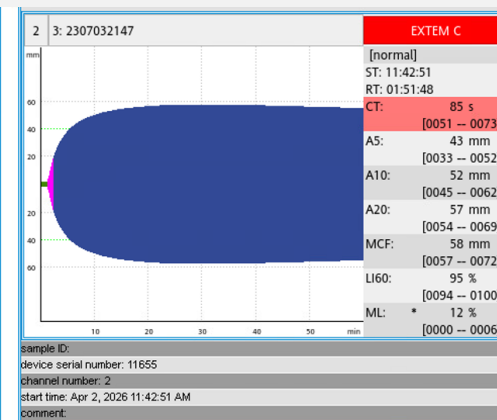
- Assesses *intrinsic portion of coagulation pathway*
- Heparin-sensitive and can reflect presence of unfractionated heparin in patient sample
- Assay is activated using *ellagic acid*





HEPTEM C

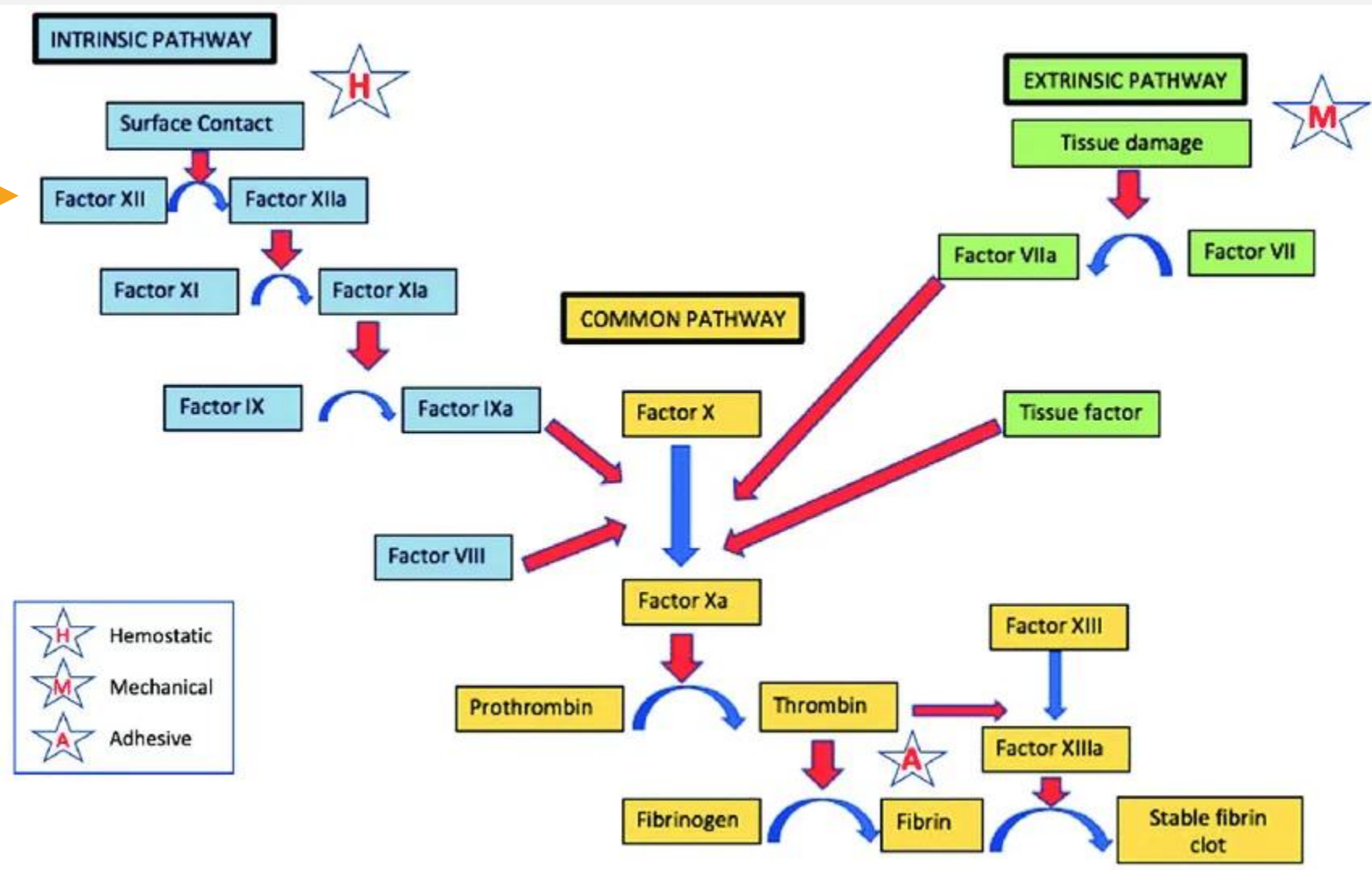
- Designed to be used in combination with INTEM C
- Assesses intrinsic coagulation pathway after neutralizing the influence of heparin with *heparinase*



HEPTEM C

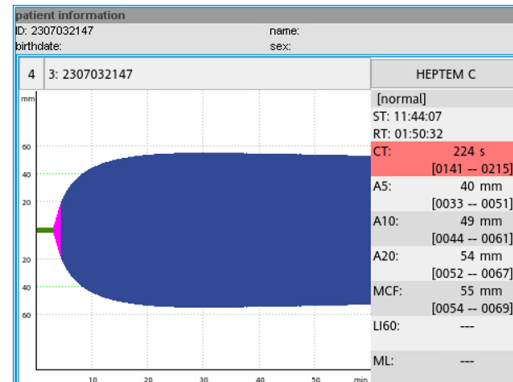
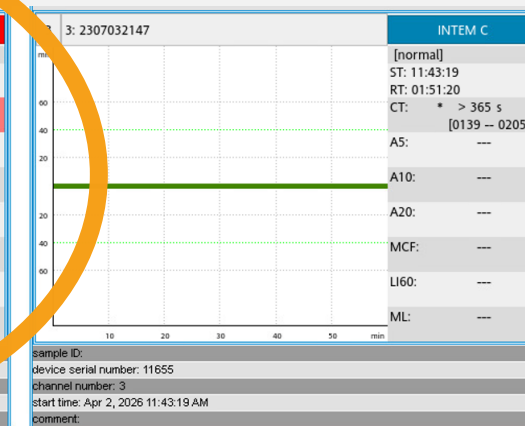
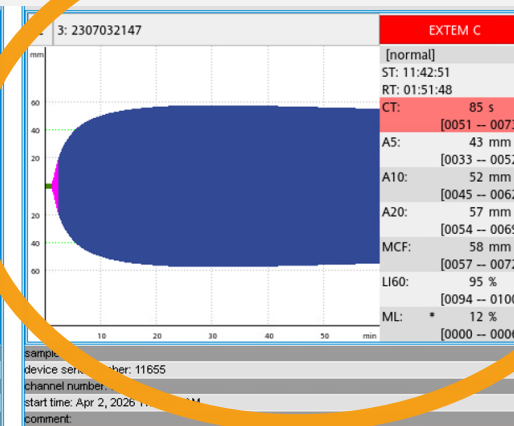
Ellagic acid
+
Heparinase

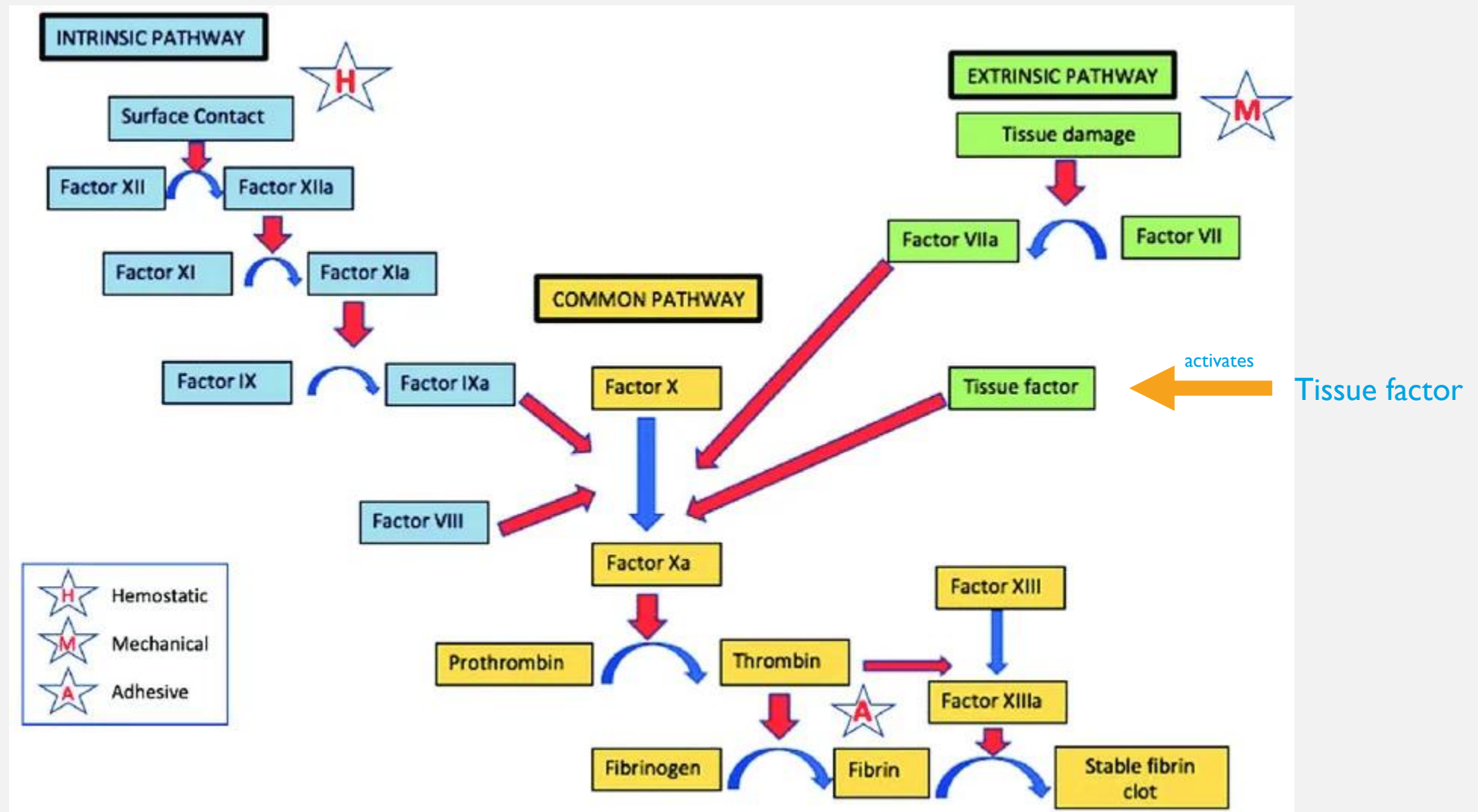
activates →



EXTEM C

- Assesses **extrinsic coagulation** pathway
- Coagulation is activated using **tissue factor**

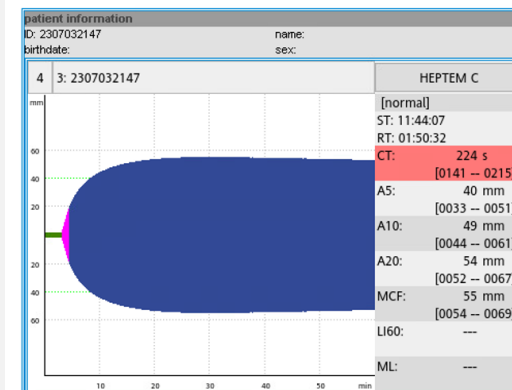
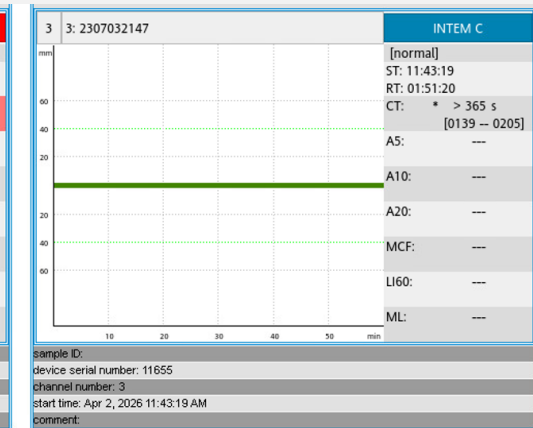
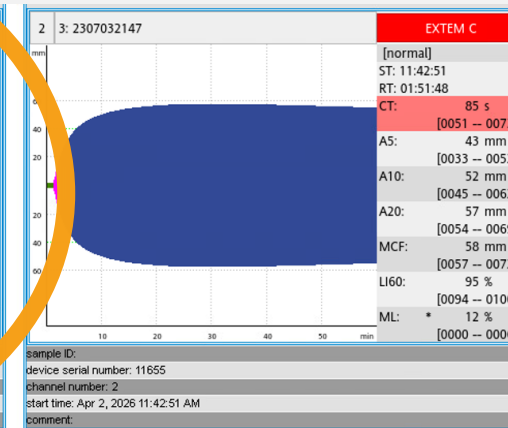
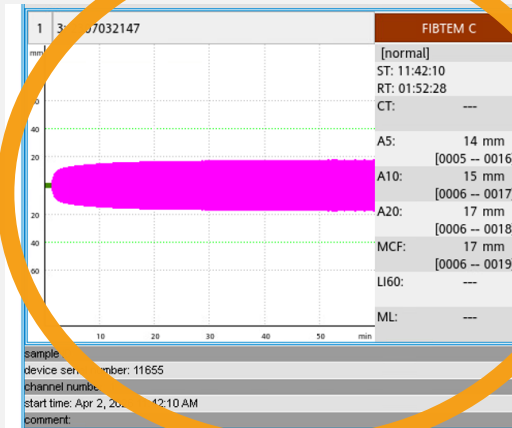
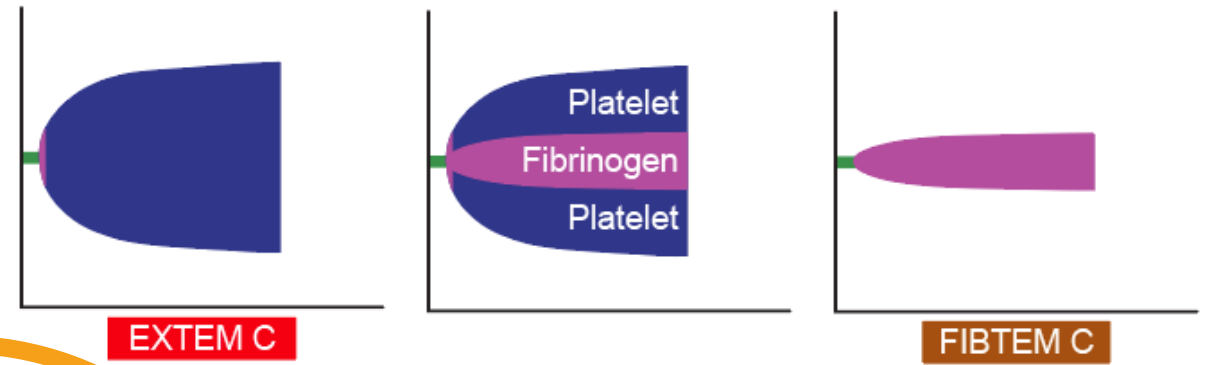


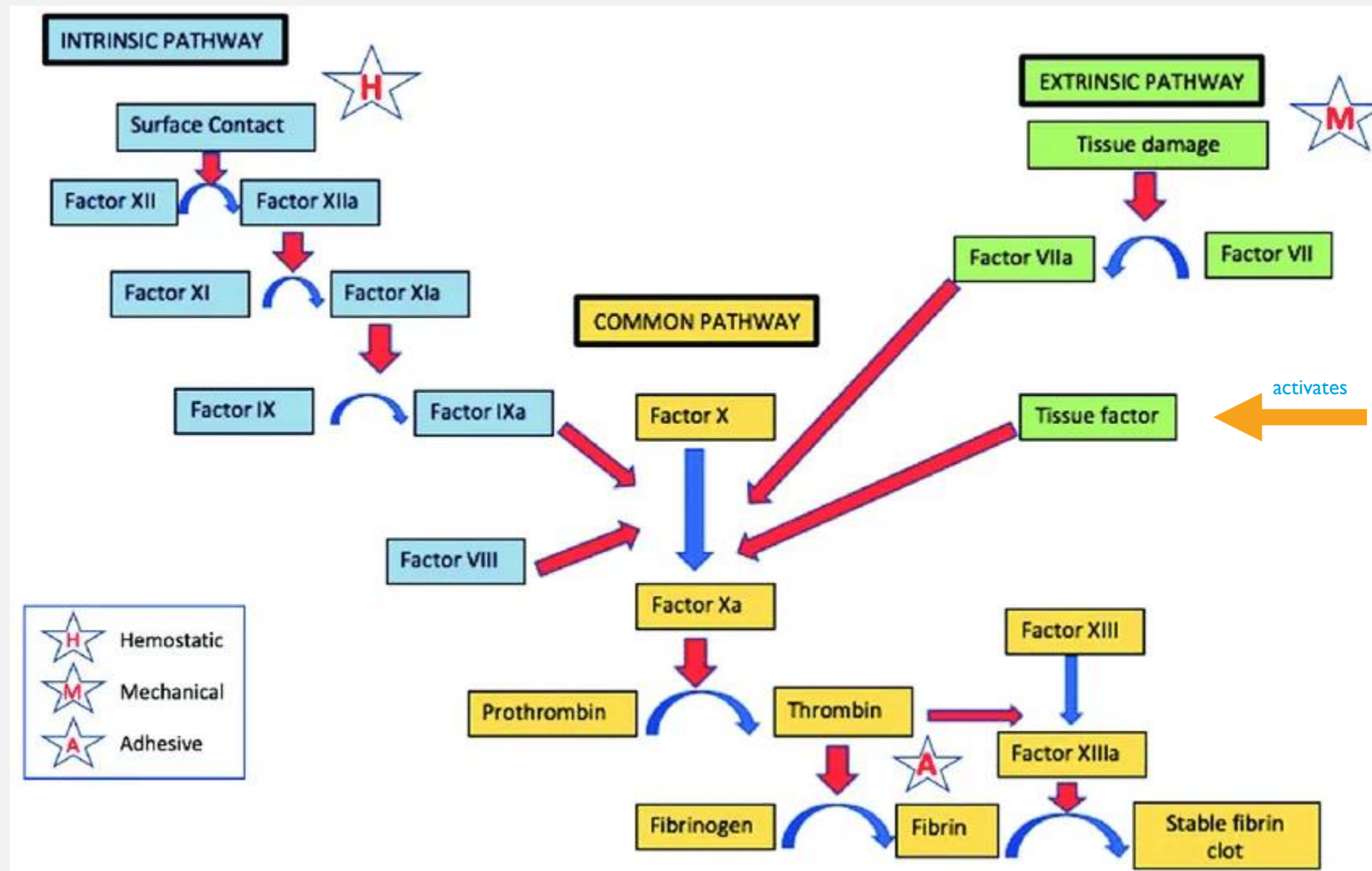


FIBTEM C

- Designed for use in combination with EXTEM C
- Assesses fibrinogen activity by **blocking** platelet contribution via **cytochalasin D**

Platelet contribution is eliminated in FIBTEM C
vs. EXTEM C





Tissue factor +
cytochalasin D
(inhibits platelets)

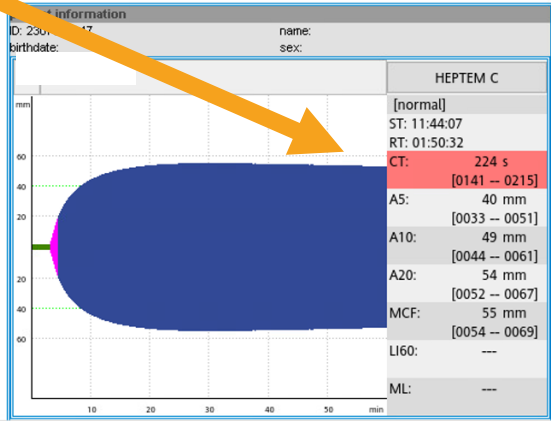
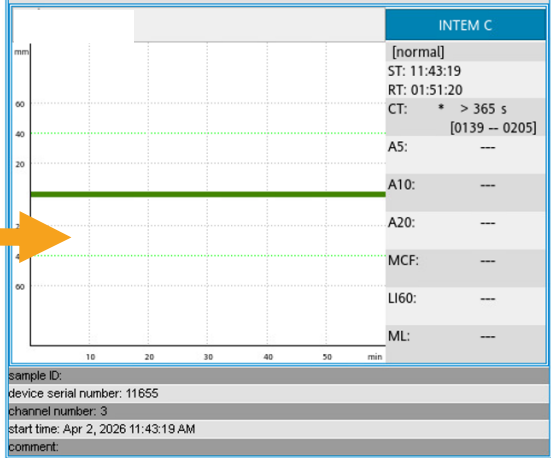
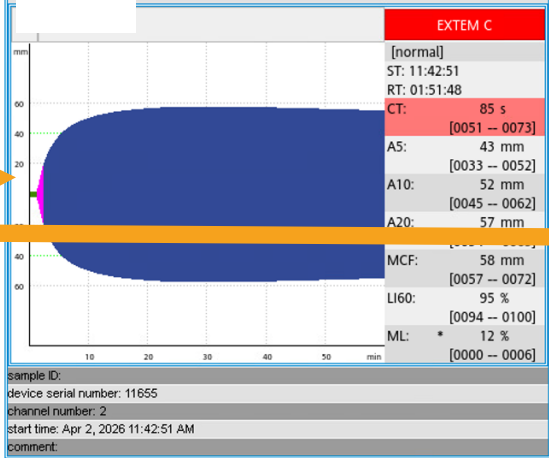
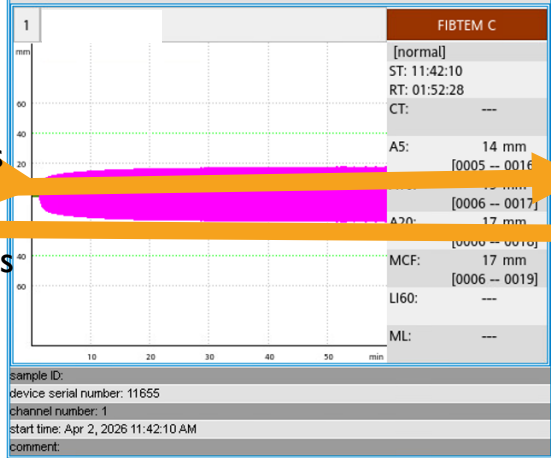
Results
displayed as
Temograms

Shape + numeric values

Shape + numeric values

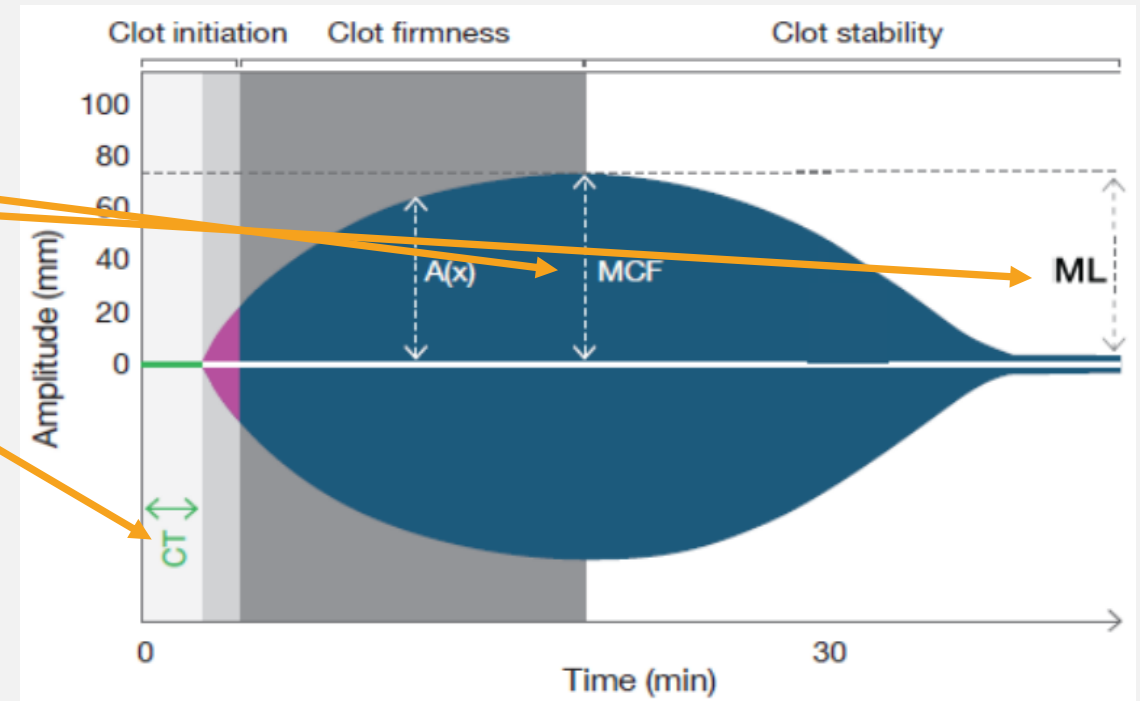
Shape + numeric values

Shape + numeric values
60 min for test
completion



KEY PARAMETERS

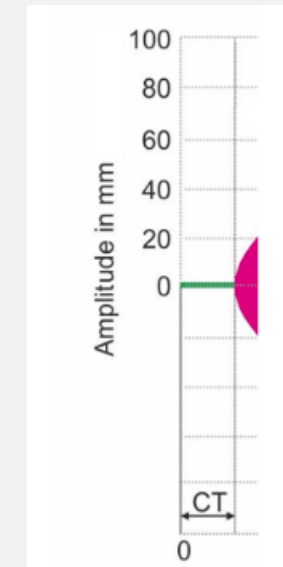
- In addition to TEMogram **shapes**, **numerical results** are evaluated
- Results fall into one of three categories:
 - Clot initiation: (CT)
 - Clot firmness: (MCF)
 - Clot stability: (ML)



CT: clotting time, $A(x)$: amplitude at x minutes after CT, MCF: maximum clot firmness, $LI(x)$: lysis index at x minutes after CT, ML: maximum lysis

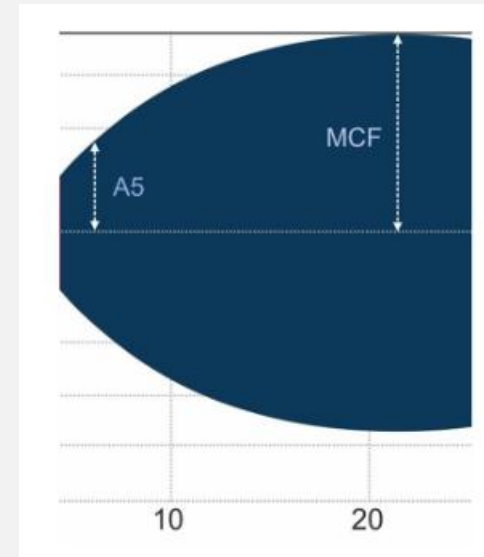
CLOT INITIATION (CLOTTING TIME)

- First result available
- Time (in sec) to reach 2 mm amplitude
 - Represents **onset of clot formation**.
 - *Example:* CT of 120 sec indicates onset of clot formation occurred in 120 sec
- Expresses information regarding **activity of clotting factors**



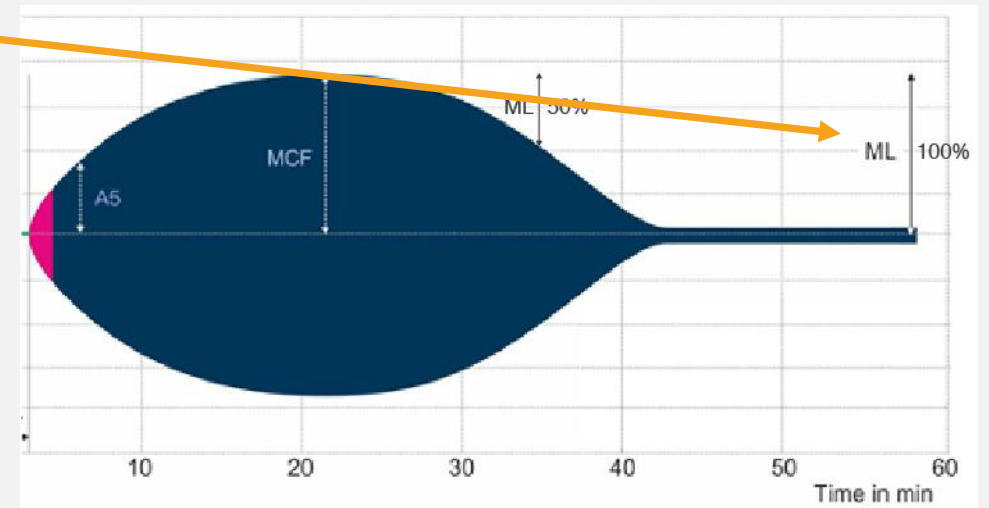
CLOT FIRMNESS

- Described through amplitude A5 and maximum clot firmness (MCF) parameters
- These parameters (in mm) reflect clot strength at different timepoints
- Expresses information ***contribution of fibrin and platelets***



CLOT STABILITY

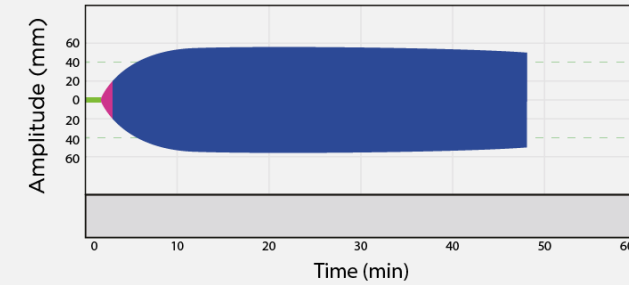
- Maximum lysis (ML), express information about ***fibrinolysis***
- ML indicates % of change in clot firmness, at time of observation, compared to MCF



CAN INTERPRET AT A GLANCE

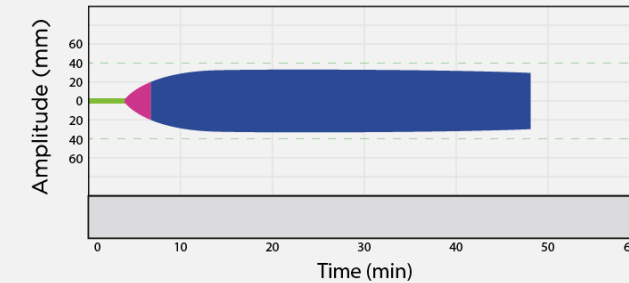
Firm and stable

Shape is indicative of clot firmness and stability



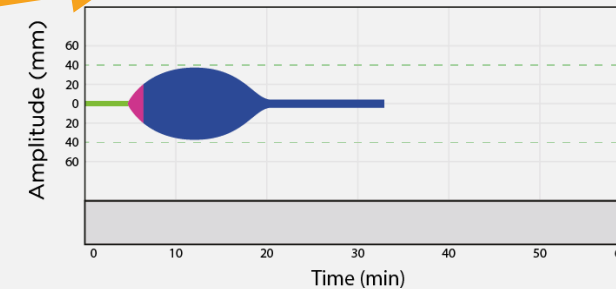
Firm and stable clot: TEMogram reaches normal/high amplitude, which does not decrease significantly over time

Reduced clot firmness, but stable



Reduced clot firmness, but stable: Decreased amplitude, which does not decrease significantly over time, indicating a weaker, but stable clot

Significant clot lysis



Significant clot lysis: Amplitude not stable with significant clot lysis

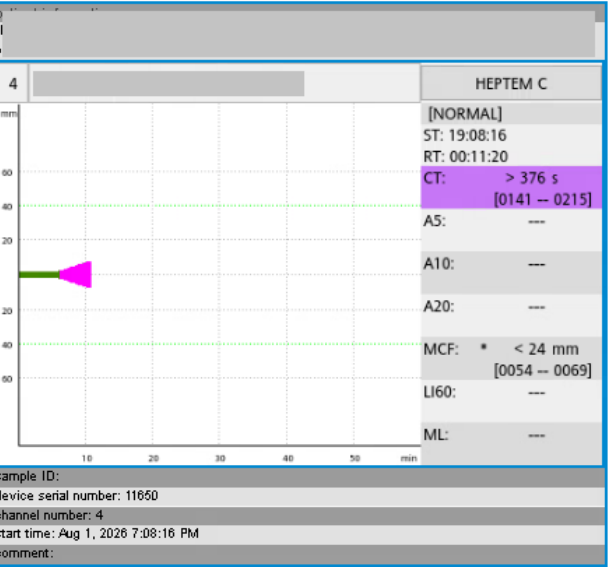
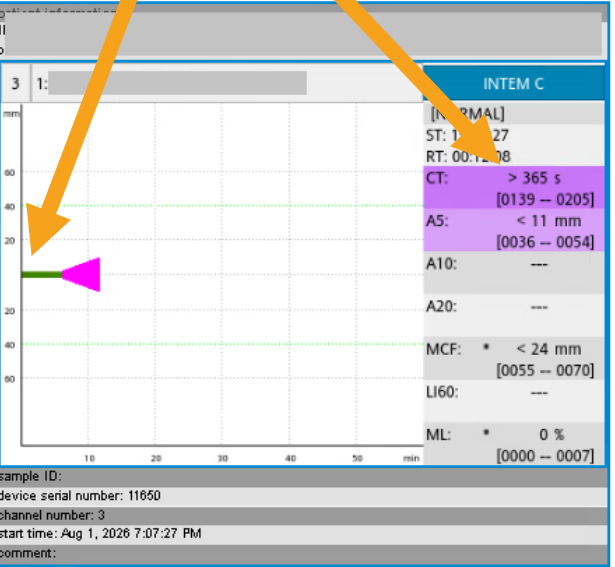
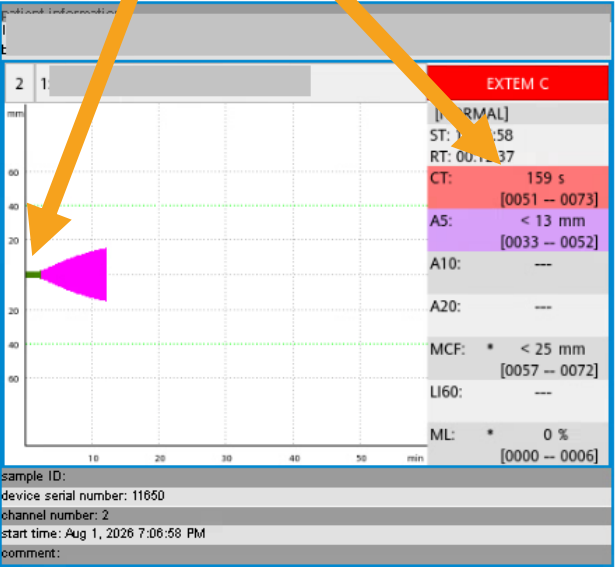
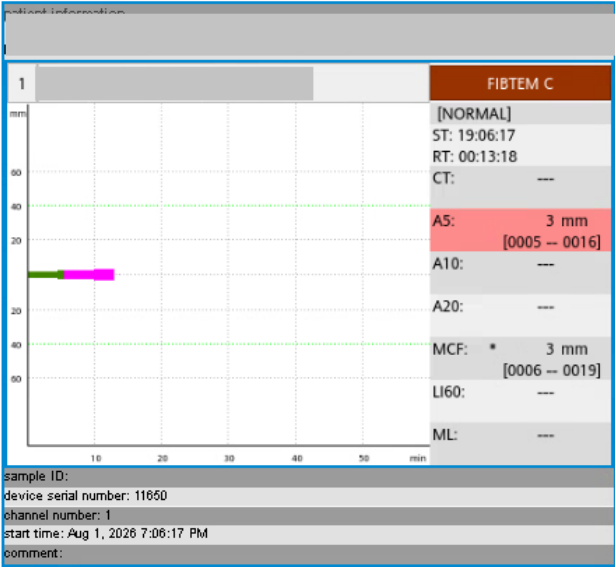
INTERPRETATION OF COMBINED ASSAY RESULTS

Low coagulation factor activity



Prolonged

Prolonged

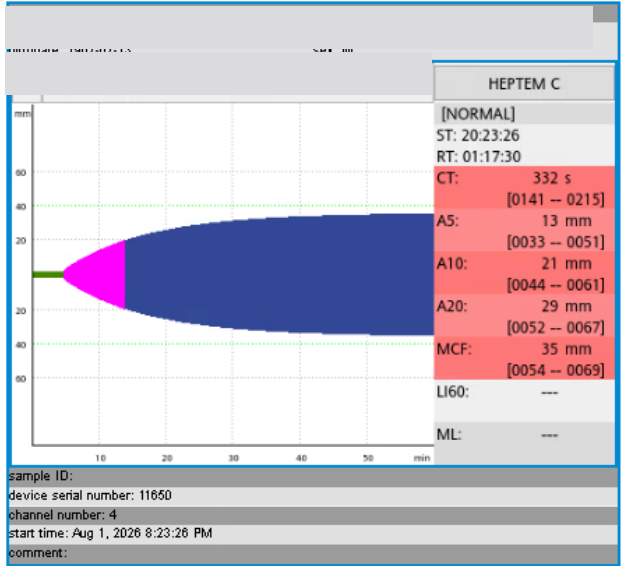
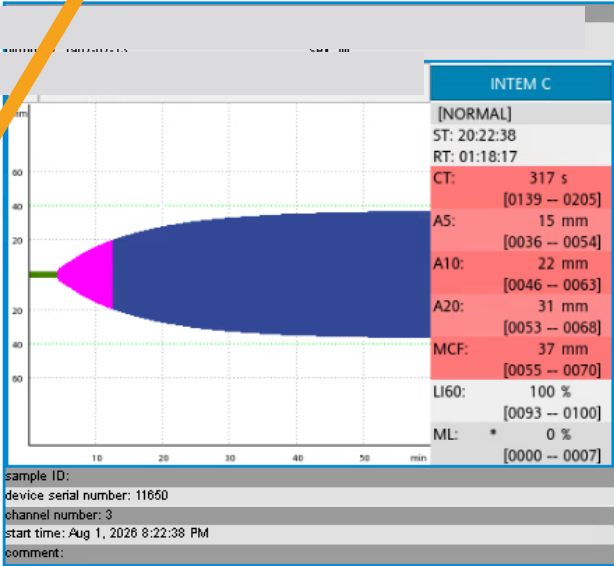
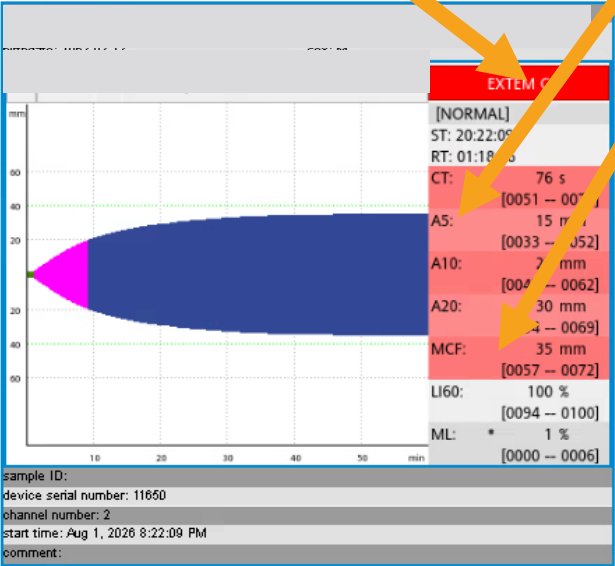
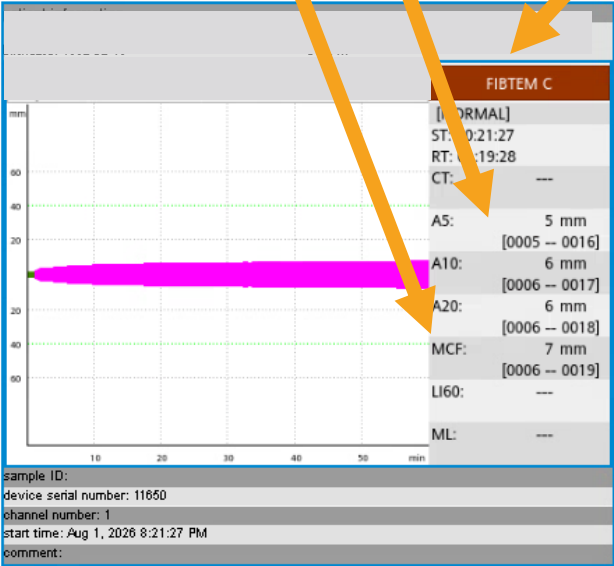


Low platelets



Normalized

Low

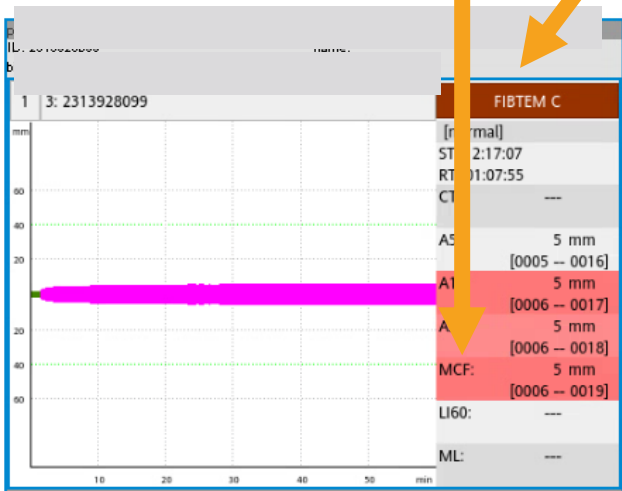


Low fibrinogen

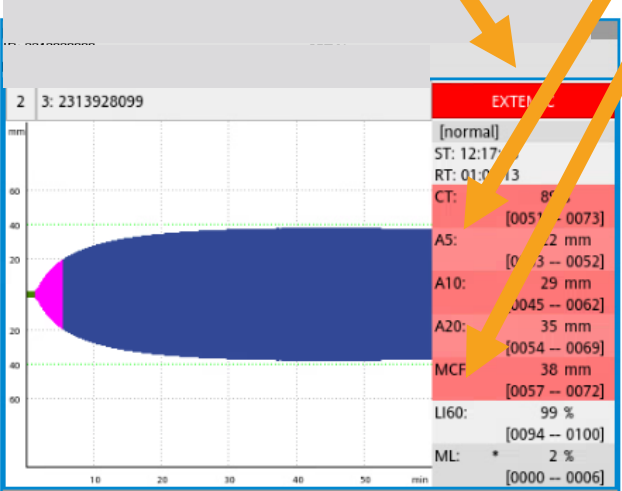


Low

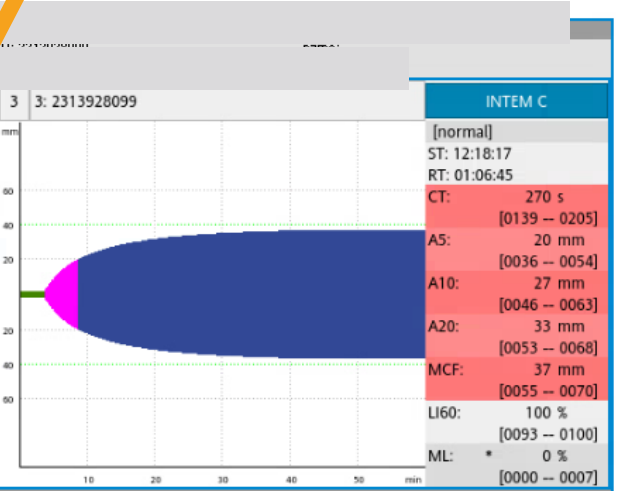
Low



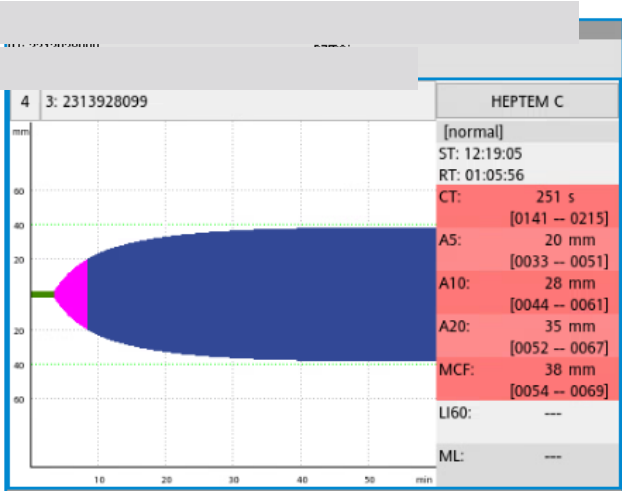
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Heparin influence



No clot
initiation

Near-normal
clot formation



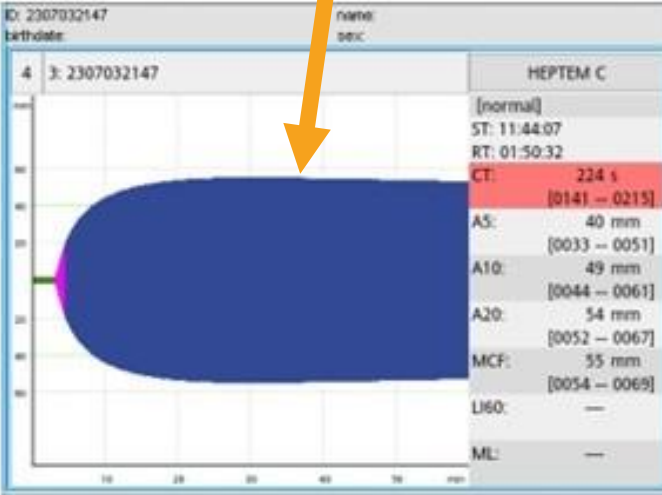
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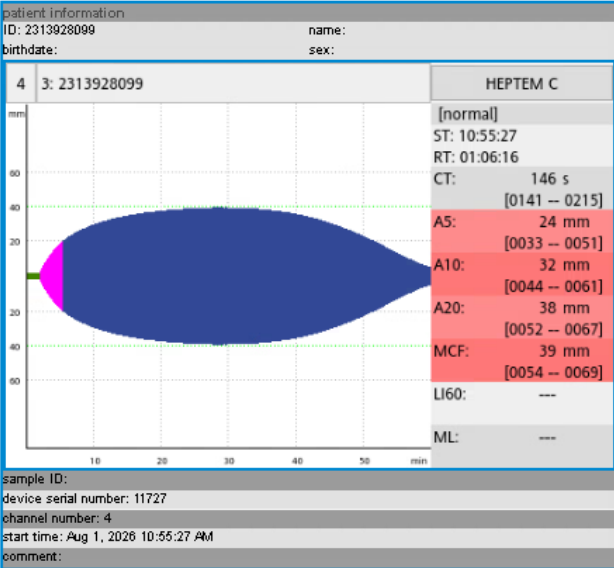
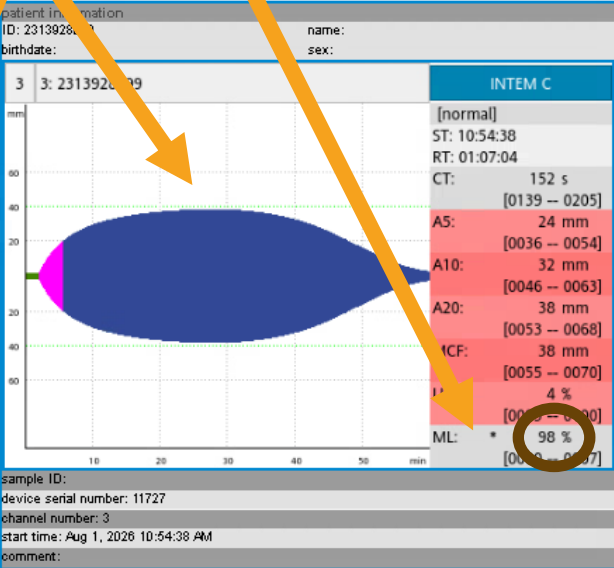
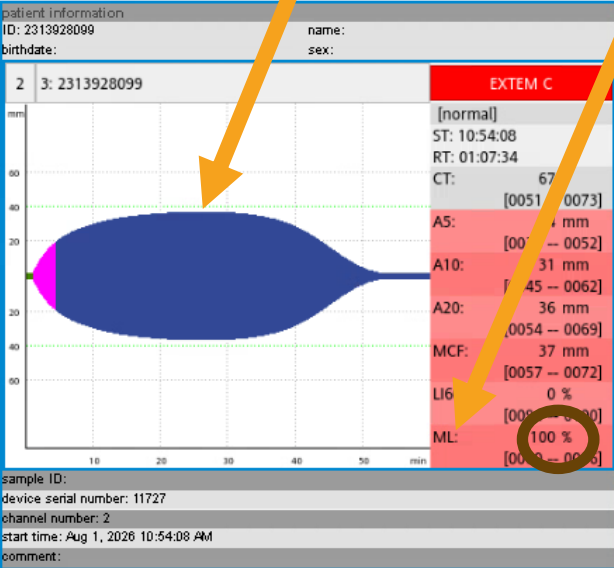
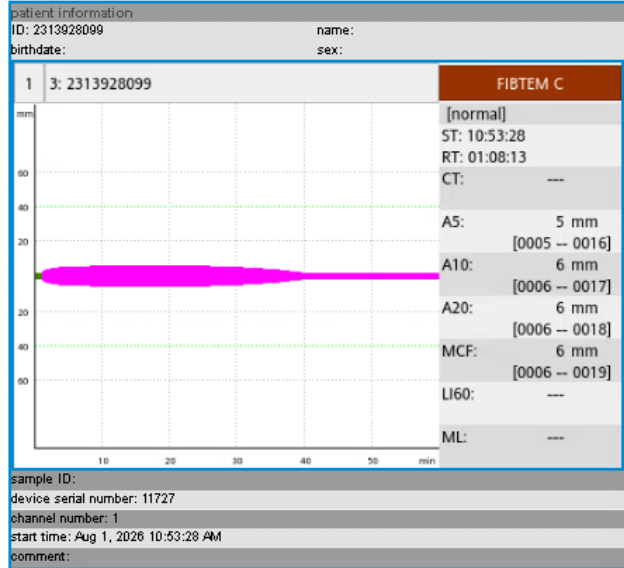


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Suggests Hyperfibrinolysis

The shape tells the story

Max lysis



IN SUMMARY

IT'S A STEEP LEARNING CURVE

IT TAKES PRACTICE

REDUCES BLOOD PRODUCT UTILIZATION