ROTEM

Channels

EXTEM- Uses Tissue Factor (TF) for activation/speed up Reaction Time, similar to EXTRINSIC PATHWAY (PT, INR)

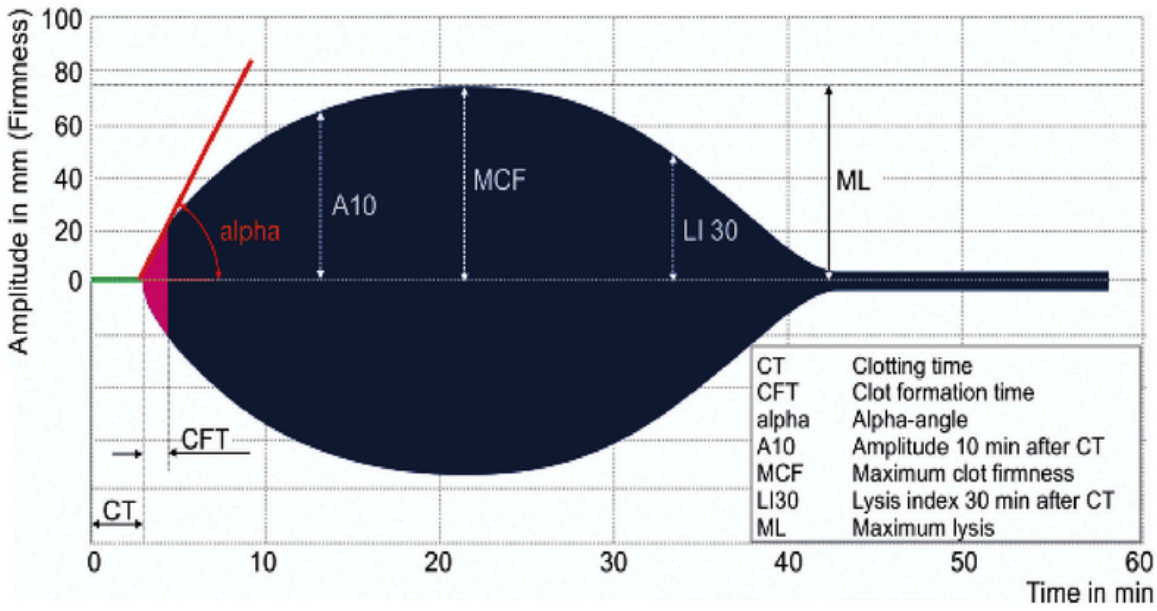
INTEM- Uses Phospholipid and Ellagic Acid for activation, similar to INTRINSIC PATHWAY (PTT)

FIBTEM- Activation as in EXTEM, but uses Cytochalasin D to inhibit platelet contribution, isolates fibrinogen contribution to clot.

APTEM- Activation as in EXTEM, but uses Aprotinin to inhibit Plasmin (TXA benefit)

HEPTEM- Activation as in INTEM, but uses Heparinase (Protamine benefit)

ECATEM- Uses Ecarin to activate Prothrombin



Clotting Time (CT)- time to 2mm clot, demonstrates the initiation of clotting, thrombin formation, start of clot polymerization. The CT describes how rapid fibrin formation starts. This measurement is initiated by adding a clot activator until an amplitude of 2 mm is reached.

Prolonged —> Give FFP/PCC or Protamine (confirm with HEPTEM)

Clot Formation Time (CFT)- The time from the measurement of CT amplitude (2mm) and the 20 mm amplitude of the clotting signal. CFT describes the rate of initial clot formation mediated by thrombin-activated platelets, fibrin and activated factor XIII. (FXIIIa).

Prolonged —> Give FFP/PCC AND/OR Platelets AND/OR Fibrinogen/Cryoprecipitate

α-angle(°) - The angle between the baseline and a tangent to the clotting curve through the 2mm CT point. The alpha-angle is indicative of the kinetics of clotting. A larger alpha angle reflects the rapid clot formation mediated by thrombin-activated platelets, fibrin and activated factor XIII (FXIIIa); CFT becomes shorter as the alpha angle becomes larger. This parameter correlates to the parameter, CFT.

Low —> Give Platelets AND/OR Fibrinogen/Cryoprecipitate

Maximum Clot Firmness (MCF)- measures clot firmness, thus, overall clot stability. MCF is the maximum amplitude that is reached prior to clot being dissolved by fibrinolysis.

A10- The clot firmness at the amplitude time point of 10 minutes after CT. Directly relates to and is highly predictable to the MCF.

INTEM/EXTEM < 40 —> Give Platelets

FIBTEM < 9 —> Give Cryo/ Fibrinogen Concentrate

Maximum Lysis- describes the degree of fibrinolysis relative to the MCF achieved during the measurement

Prolonged (>15% within 1 hour) —> Give TXA (confirm with APTEM)

ROTEM® Reference values

test name (reagent)	CT (s)	CFT (s)	α Angle	A10(mm)	A15(mm)	A20(mm)	A25(mm)	MCF(mm)	CLI 30(%)	ML (%)[2]
INTEM	100-240	30-110	70-83	44-66	48-69	50-71	50-72	50-72	94-100	< 15
HEPTEM	*Comparison with INTEM. A better clot quality in HEPTEM as compared to INTEM indicates the presence of heparin or heparin-like anticoagulants in the sample.*									
EXTEM	38-79	34-159	63-83	43-65	48-69	50-71	50-72	50-72	94-100	< 15
APTEM	*Comparison with EXTEM. A better clot formation with ap-TEM® or APTEG-S when compared to ex-TEM® is an early sign of hyperfibrinolysis.*									
FIBTEM	n.d	n.d	n.d	7-23	n.d	8-24	n.d	9-25	n.d	n.d
	MCF <9 mm is a sign of decreased fibrinogen or disturbed clot polymerisation. MCF > 25 mm is a sign of elevated fibrinogen levels (which may lead to a normal EXTEM or INTEM in spite of thrombocytopenia).									
NATEM	300-1000[4]	150-700 [4]	30-70 [4]			35-60 [4]		40-65 [4]	94-100 [4]	< 15 [4]

Referenz: Lang T, Bauters A, Braun SL, Poetzsch B, von Pape K-W, Kolde H-J, Lakner M. Multi-centre investigation on reference ranges for ROTEM® thromboelastometry (eingereicht in Blood Coagulation and fibrinolysis)

Normal haemostasis with different tests

EXTEM & INTEM

- Normal CT
- Normal amplitudes
- No hyperfibrinolysis visible

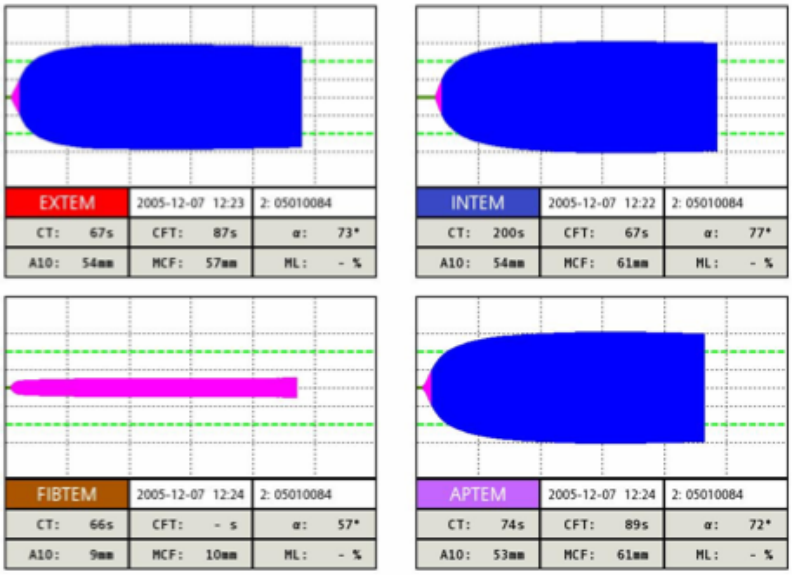
FIBTEM: Amplitude normal

=> fibrinogen level sufficient

&

EXTEM: Amplitude normal

=> platelets normal



APTEM ≈ EXTEM

=> No hyperfibrinolysis

Test specificities: APTEM

APTEM:

- activation as in EXTEM
- fibrinolysis inhibition with aprotinin

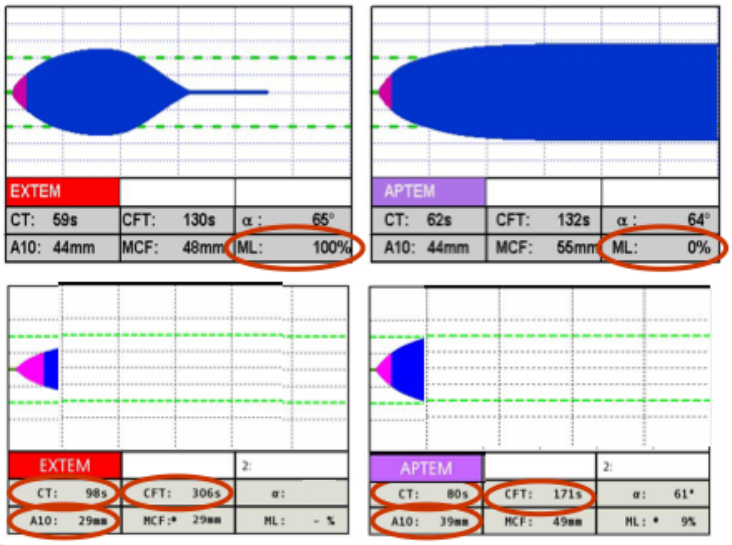
TEMogram identifies hyperfibrinolysis

A) • EXTEM: clear hyperfibrinolysis (ML 100%)
• APTEM: fibrinolysis inhibited (ML <15%)

=> Fulminant hyper-fibrinolysis

B) • APTEM:
CT > 10% shorter &
CFT > 20% shorter &
A10 higher than EXTEM
(or 2 out of 3)

=> Consider mild hyper-fibrinolysis which will become visible later during measurement



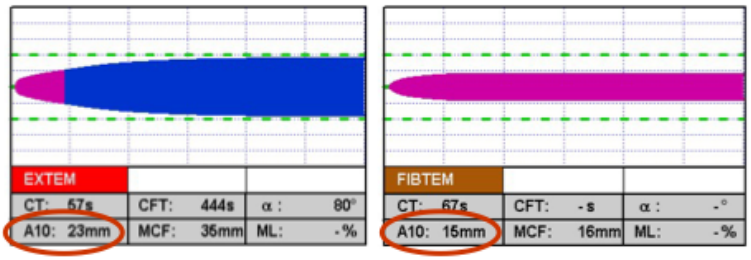
Test specificities: FIBTEM

FIBTEM:
- activation as in EXTEM
- platelet inhibition reagent added

⇒ TEMogram shows isolated fibrinogen contribution to Clot firmness

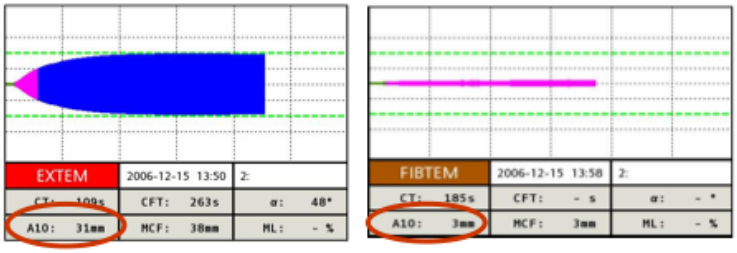
A)
- EXTEM: amplitude low
- FIBTEM: amplitude normal

=> fibrinogen level OK
=> platelet deficiency



B)
- EXTEM: amplitude low
- FIBTEM: amplitude low

=> fibrinogen deficiency



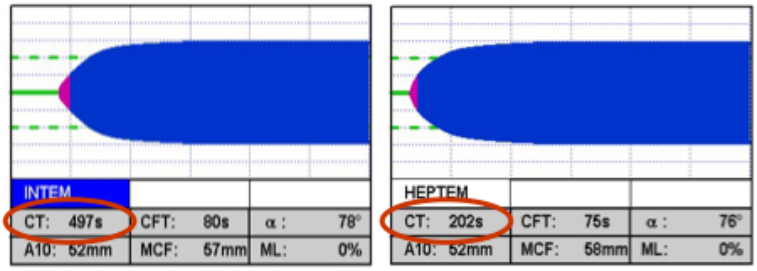
Test specificities: HEPTEM

HEPTEM:
- activation as in INTEM
- heparin inhibition with heparinase

⇒ TEMogram identifies heparin effects

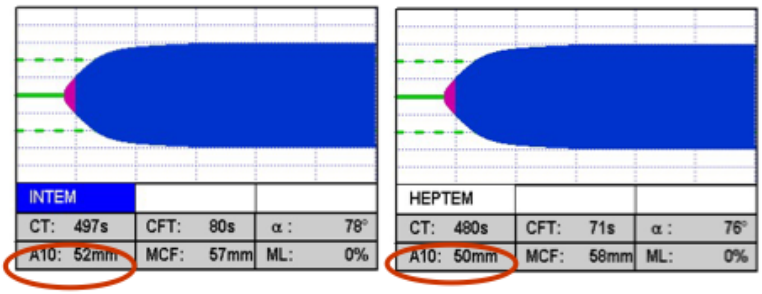
A)
- INTEM: CT long
- HEPTEM: CT normalised

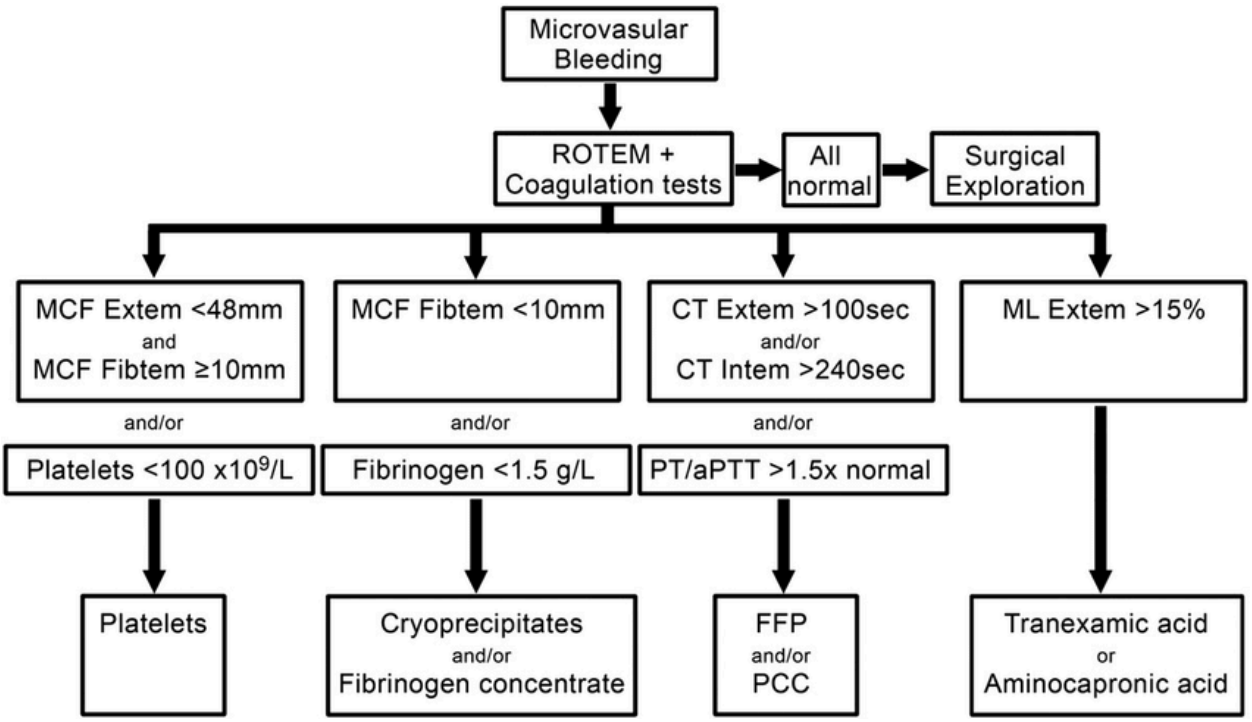
⇒ Heparin effect

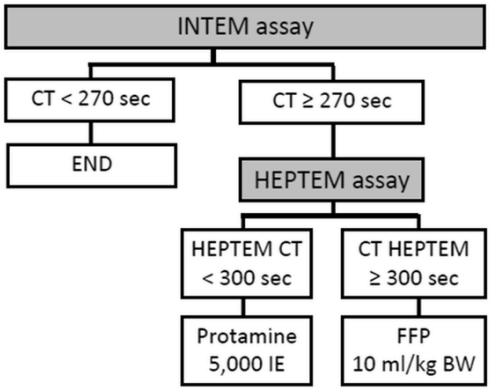


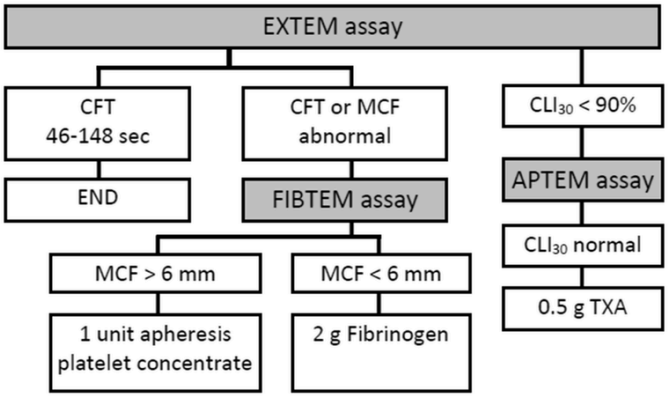
B)
- INTEM: CT long
- HEPTEM: CT also long

⇒ No heparin effect
⇒ Factor deficiency (limited sensitivity to isolated single factor deficiency)




Microvasular Bleeding
ROTEM + Coagulation tests
All normal
Surgical Exploration
MCF Extem <48mm
and
MCF Fibtem ≥10mm
MCF Fibtem <10mm
CT Extem >100sec
and/or
CT Intem >240sec
ML Extem >15%
and/or
and/or
and/or
Platelets <100 x10⁹/L
Fibrinogen <1.5 g/L
PT/aPTT >1.5x normal
Platelets
Cryoprecipitates
and/or
Fibrinogen concentrate
FFP
and/or
PCC
Tranexamic acid
or
Aminocapronic acid


INTEM assay
CT < 270 sec
CT ≥ 270 sec
END
HEPTEM assay
HEPTEM CT < 300 sec
CT HEPTEM ≥ 300 sec
Protamine 5,000 IE
FFP 10 ml/kg BW


EXTEM assay
CFT 46-148 sec
CFT or MCF abnormal
CLI30 < 90%
END
FIBTEM assay
APTEM assay
CLI30 normal
MCF > 6 mm
MCF < 6 mm
0.5 g TXA
1 unit apheresis platelet concentrate
2 g Fibrinogen