AWSOME

Anaesthesia Written ShOrt answer & Multiple choice Examination Course

Coagulation

David Connor

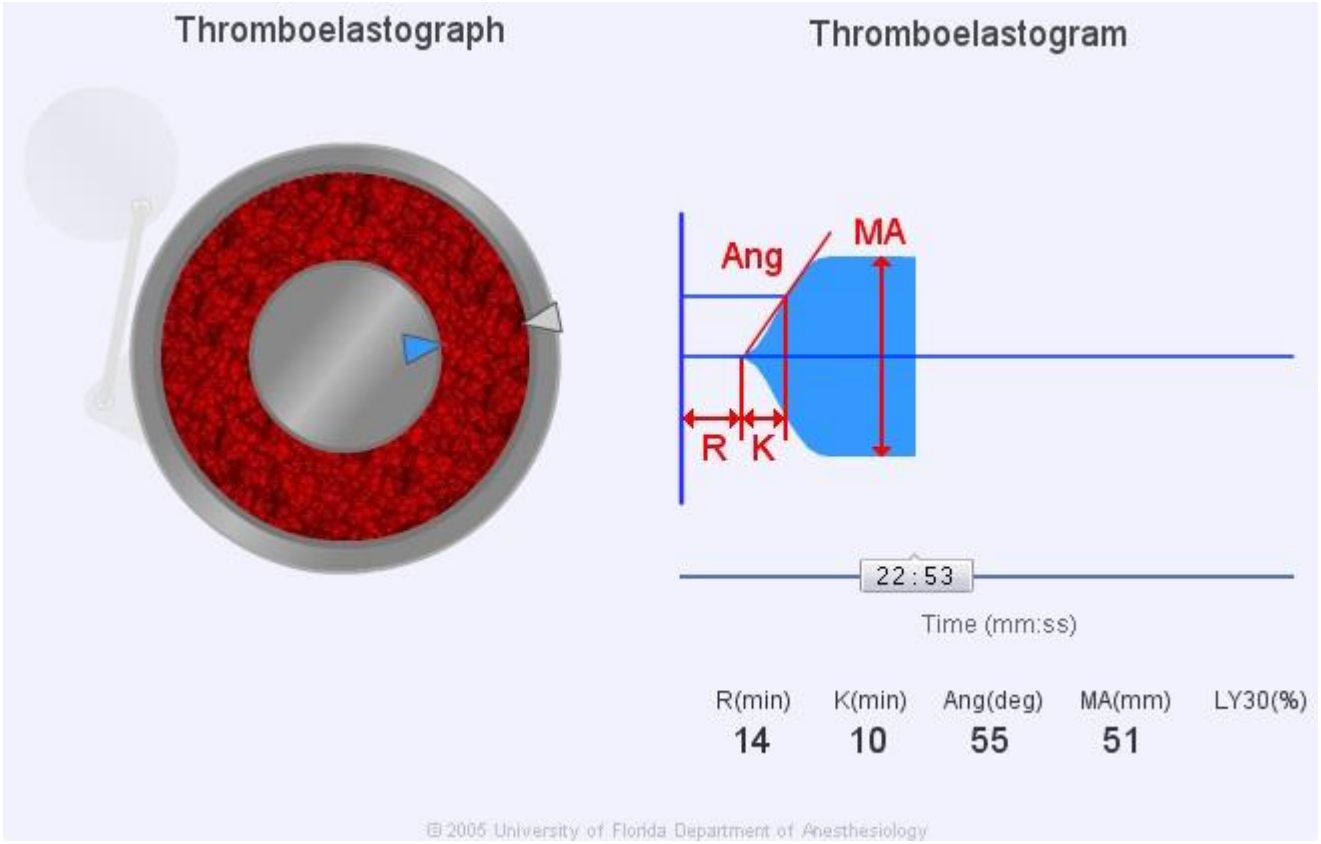
- Revised clotting cascade
  - Platelet
  - Tissue factor initiation
  - Thrombin regeneration
  - Control of clotting (Protein C & S)
  - Fibrinolysis
- TEG/ROTEM
  - Revision of terminology
  - Examples of several abnormal traces
- Drugs
  - Diagram illustrating sites of anti-platelet action
  - Diagram illustrating sites of LMWH/heparin/newer agents
  - New guidance on regional blocks post anti-coagulants
- RFVII
  - Mechanism of action
  - Evidence base
  - Role

Thromboelastography (TEG)

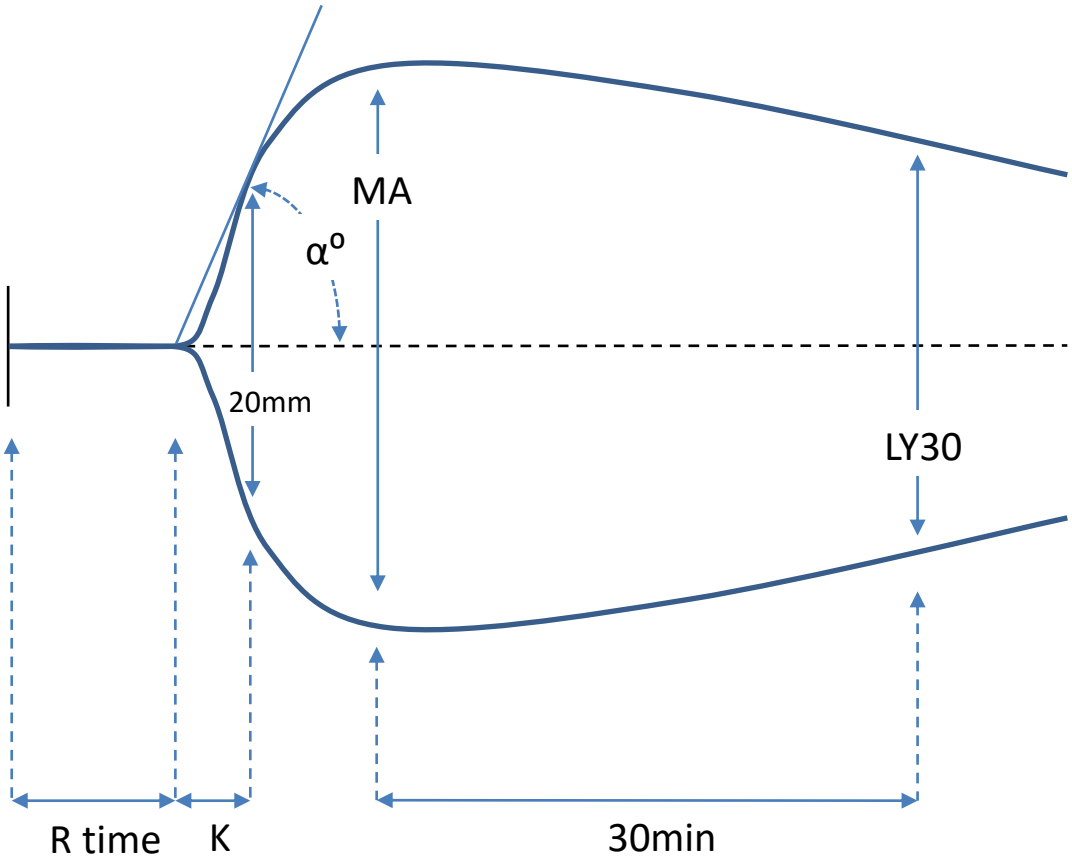
Procedure

- Fresh blood sample
- Analyse immediately
- Activate with kaolin
- Warmed to 37^{o}C
- Two channels – can add other enzymes for more detailed analysis of clotting cascade

How does it work?

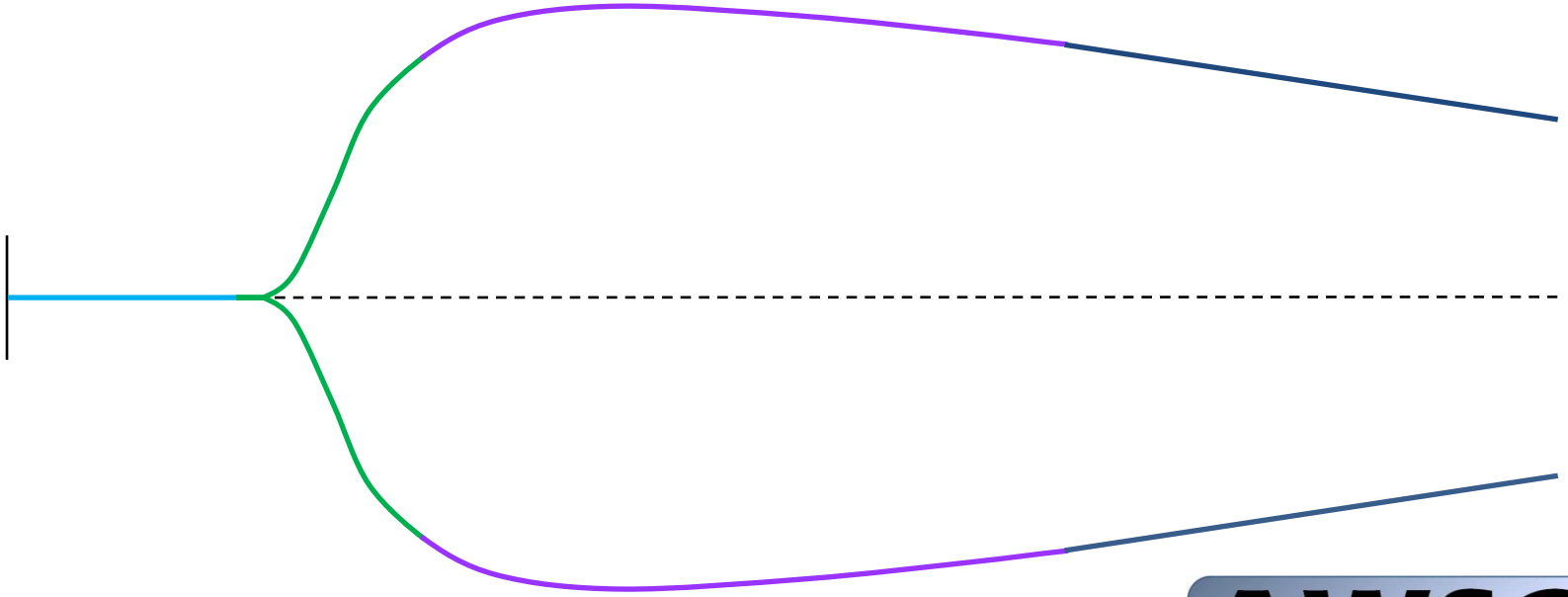


TEG definitions



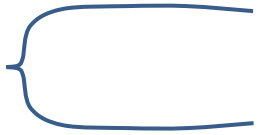
- Reaction time
  - Time from initiation until amplitude reaches 2 mm
  - Corresponds to initial fibrin formation
- K time
  - Time until amplitude reaches 20 mm
  - Measure of clot formation kinetics
- α angle
  - Angle formed by a line connecting the R & K times
  - Relates directly to the *K*-time as they are both a function of rate of fibrin polymerisation
  - Measure of clot formation kinetics
- Maximum amplitude (MA)
  - Greatest amplitude reached
  - Representative of maximum clot strength
  - Directly related to the quality of fibrin and platelet interaction with platelets having the greatest influence
- LY30
  - Percentage lysis 30 min after MA is reached
  - Measurement based upon the reduction in area under the trace, rather than just amplitude

R time	K time α angle	MA	LY30
Clot time	Clot rate	Maximum clot strength	Clot stability
8-12 mm	2-4 mm 66-77°	60-75 mm	<7.5%
Coagulation pathways	Fibrinogen IIa Platelets	Platelets (80%) Fibrinogen (20%)	Fibrinolysis
FFP	FFP Platelets Cryo	Platelets	Cryoprecipitate Tranexamic acid



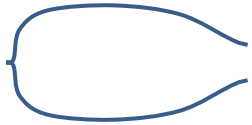
Interpreting abnormal TEG results

Normal



Hypercoagulation
- Decreased R & K
- Increased MA & α angle

Anticoagulants or haemophilia
- Factor deficiency
- Prolonged R & K
- Decreased MA & α angle



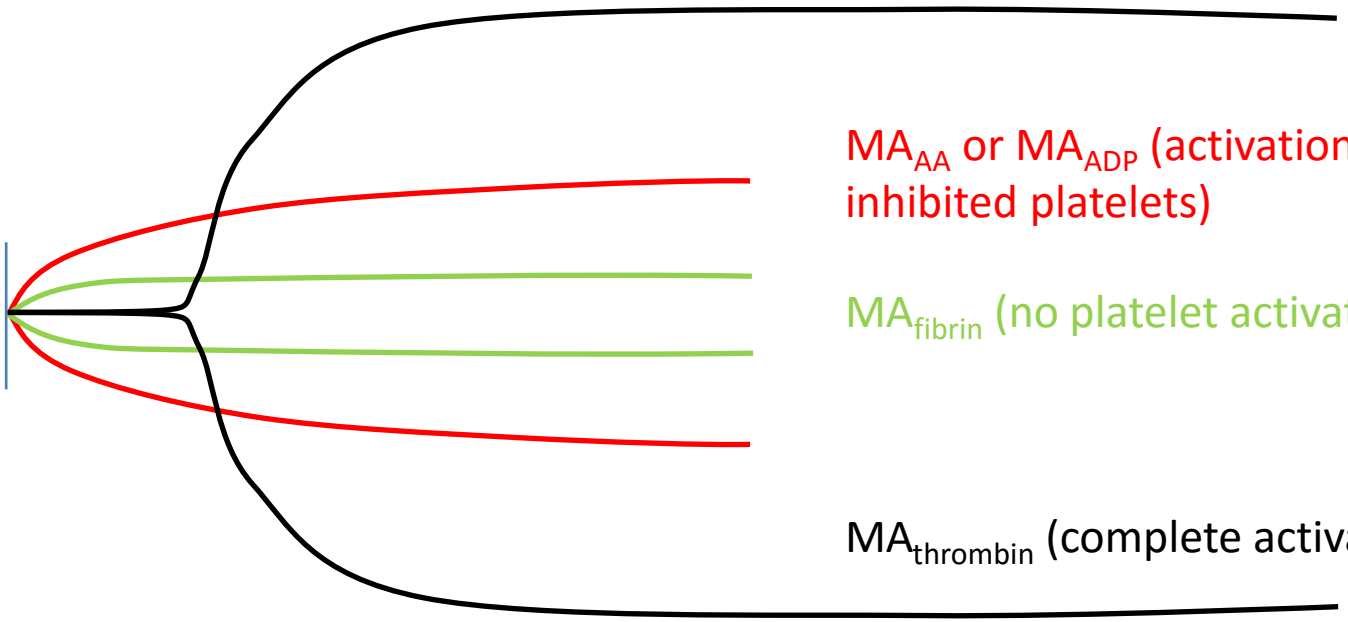
Stage 1 DIC
- Hypercoagulable with fibrinolysis

Thrombocytopaenia
- Normal R
- Prolonged K
- Decreased MA

Stage 2 DIC
- Hypercoagulable with exhaustion of clotting factors

Fibrinolysis
- Presence rTPA
- Normal R
- LY30 >7.5%

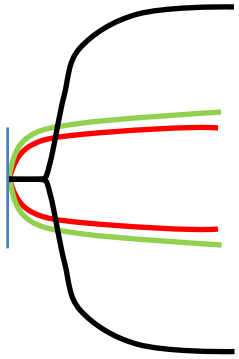
Platelet mapping



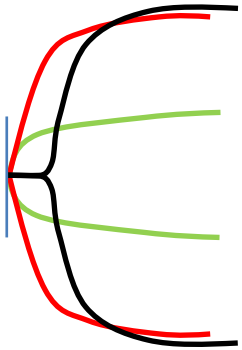
- $MA_{thrombin}$
  - Kaolin with citrate
- MA_{fibrin}
  - Heparinised
  - Reptilase and factor XIII (Activator F)
- MA_{AA} or MA_{ADP}
  - Heparinised
  - Activator F
  - AA or ADP respectively

$$\boldsymbol{Platelet\ inhibition}\ (\%) = 100 - \left[\frac{MA_{AA} - MA_{fibrin}}{MA_{thrombin} - MA_{fibrin}} \times 100\right]$$

Patient on aspirin



AA assay	mm
$MA_{thrombin}$	74.1
MA_{fibrin}	28.2
MA_{AA}	20.5
% Platelet inhibition	100



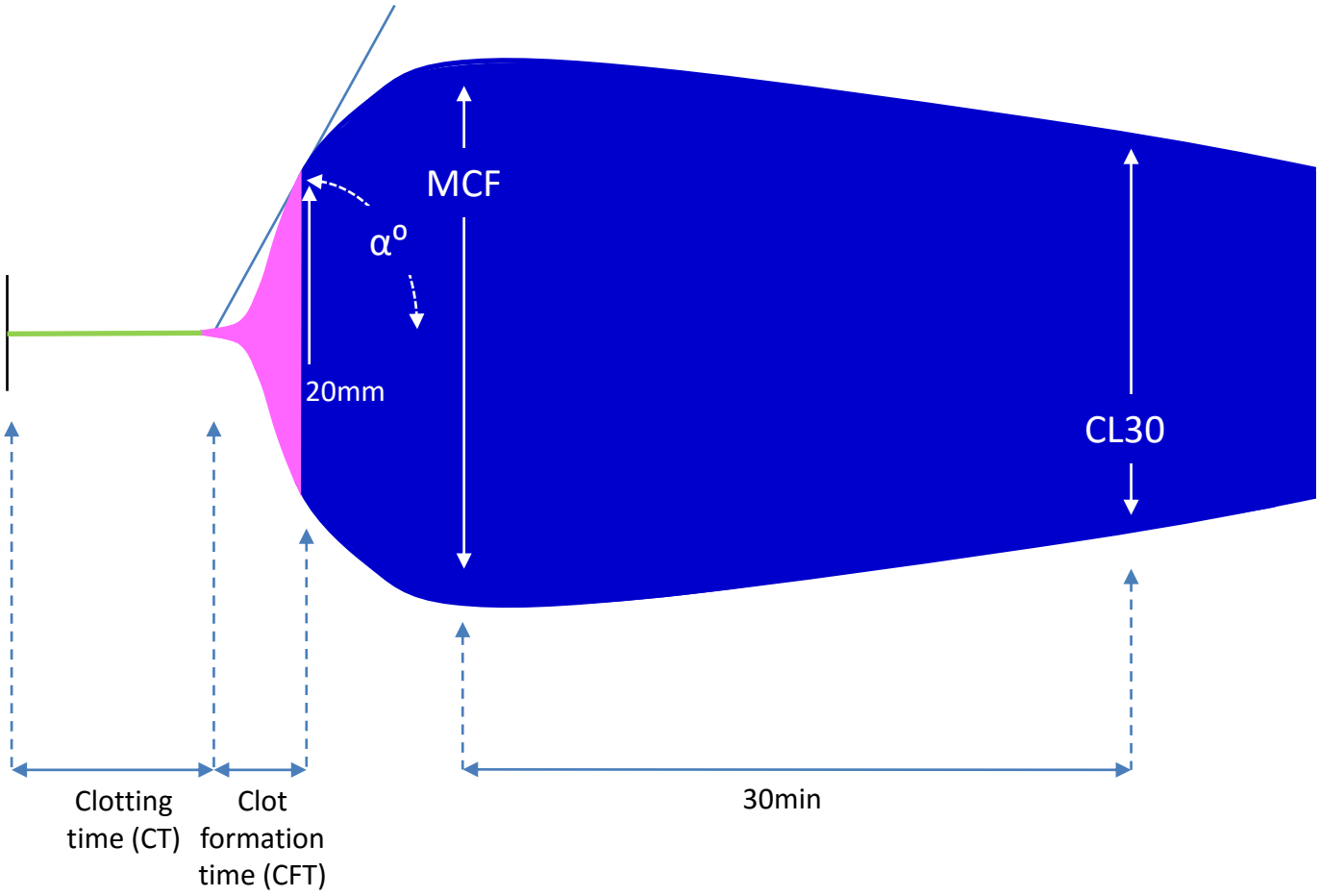
ADP assay	mm
$MA_{thrombin}$	74.1
MA_{fibrin}	28.2
MA_{ADP}	71.4
% Platelet inhibition	5.9

Rotational thromboelastometry (ROTEM)

Procedure

- Citrated blood sample
- Can be analysed later
- Warmed 37^{o}C
- Activated with tissue factor (TF) or Contact factor (CF)
- Four channels

ROTEM definitions



ROTEM modifications

Test	Interpretation
INTEM	Contains phospholipid and ellagic acid Equivalent to APTT
EXTEM	Contains Tissue Factor Equivalent to PT
HEPTEM	Contains lyophilised heparinase Neutralises heparin effect
APTEM	Contains aprotinin Inhibits fibrinolysis
FIBTEM	Contains cytochalasin D (a platelet inhibitor) Allows analysis of the fibrin contribution
ECATEM	Contains ecarin Quantifies the effects of direct thrombin inhibitors (lepirudin, dabigatran)

Anti-coagulants & regional anaesthesia: Draft guidance AAGBI 2012

Table 1 – Recommendations relating to drugs used to modify coagulation

Drug	Time to peak effect	Elimination Half-life	Acceptable time after drug for block performance	Acceptable time for next drug dose after block	Acceptable time after drug for catheter removal	Acceptable time after catheter removal for next drug dose
Heparins						
UFH s.c. prophylactic	<30 min	1-2 h	4 h and normal APTT	1 h	4 h and normal APTT	1 h
UFH i.v. treatment	<5 min	1-2 h	4 h and normal APTT	4 h	4 h and normal APTT	4 h
LMWH s.c. prophylactic	3-4 h	3-7 h	12 h	4 h	12 h	4 h
LMWH s.c. treatment	3-4 h	3-7 h	24 h	4 h	24 h	4 h
Heparin alternatives						
Lepirudin	0.5-2 h	2-3 h	10 h	4 h	10 h	4 h
Desirudin	0.5-2 h	2-3 h	10 h	4 h	10 h	4 h
Bivalirudin	5 min	25 min	10 h	4 h	10 h	4 h
Argatroban	<30 min	30-35 min	4 h	2h	4 h	2 h
Fondaparinux*	1-2 h	17-20 h	>36 h	12 h	42 h	12 h
Antiplatelet drugs						
NSAIDs	1-12 h	1-12h	No additional precautions			
Aspirin	12-24 h	Not relevant	No additional precautions			6 h
Clopidogrel	12-24 h	Irreversible effect	7days	After block performance	7 days	6 h
Ticlopidine	8-11 days	24-32 h but 90 h in chronic use	10 days	After block performance	10 days	6 h
Tirofiban	<5 min	4-8 h	8 h	After block performance	8 h	After catheter removal
Eptifibatide	<5 min	4-8 h	8 h	After block performance	8 h	After catheter removal
Abciximab	<5 min	24-48 h	48 h	After block performance	48 h	After catheter removal
Dipyridamole	75 min	10 h	No additional precautions			6 h
Oral anticoagulants						
Warfarin	3-5 days	4-5 days	INR ≤1.4	After catheter removal	INR ≤1.4	1 h
Rivaroxaban*	3 h	7-9 h	21 h	5 h	*	*
Dabigatran†	0.5-2.0 h	12-17 h	36 h	6 h	†	†
Thrombolytic drugs						
Alteplase, anistreplase reteplase, streptokinase	<5 min	4-24 min	Contraindicated	Contraindicated	Not applicable	10 days

Notes: The data used to populate this table are derived from the German guidelines adopted by ESRA [2], the ASRA guidelines [1] and data presented by drug manufacturers. Ticlopidine no longer has a UK licence. These recommendations relate primarily to neuraxial blocks.

Abbreviations: UFH = unfractionated heparin, APTT = activated partial thromboplastin time, LMWH = low molecular weight heparin, s.c. = subcutaneous, i.v. = intravenous, NSAIDs = non-steroidal anti-inflammatory drugs, INR = international normalised ratio

* Manufacturer recommends caution with use of neuraxial catheters

† Manufacturer recommends that neuraxial catheters are not used