Thromboelastogram (TEG) Learning for Nurses

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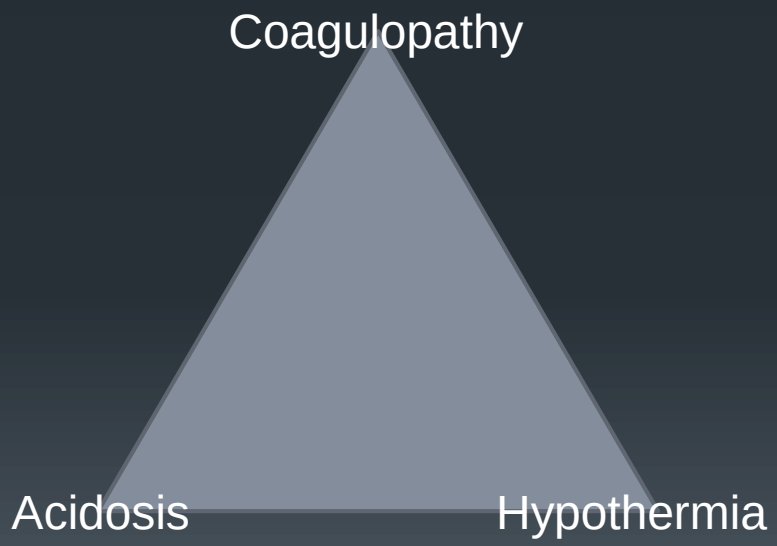
Objectives

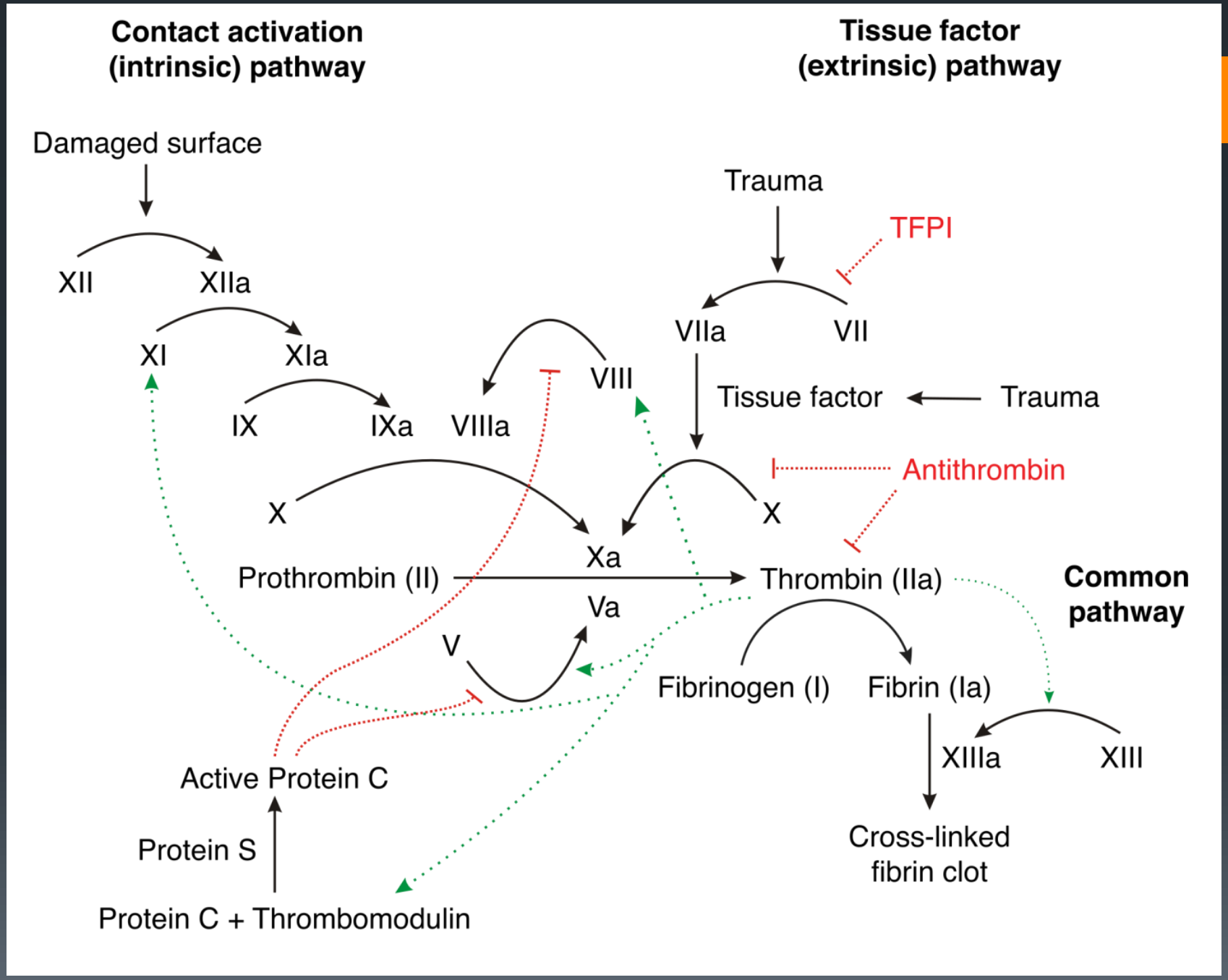
1. Discuss the “coagulopathy of trauma” and how it may be detected by conventional coagulation tests.
2. Describe thromboelastography (TEG) and interpret the results.
3. Discuss how TEG may be used to guide blood product administration.

Coagulopathy is a part of the “lethal triad” of trauma



Coagulation

- Coagulopathy occurs in 25% of trauma patients usually within the first 15 minutes
- Normal coagulation is ESSENTIAL in trauma patients to stop ongoing hemorrhage
- Remember that there are two major pathways to involved in the initiation of clot formation


Contact activation
(intrinsic) pathway
Tissue factor
(extrinsic) pathway
Damaged surface
XII
XIIa
XI
XIa
IX
IXa
VIII
VIIIa
Trauma
TFPI
VIIa
VII
Tissue factor
Trauma
Antithrombin
X
X
Xa
Prothrombin (II)
Thrombin (IIa)
Common
pathway
Va
V
Fibrinogen (I)
Fibrin (Ia)
XIIIa
XIII
Cross-linked
fibrin clot
Active Protein C
Protein S
Protein C + Thrombomodulin

How do we measure coagulation?

- Prothrombin time (PT) and International Normalized Ratio (INR) measures extrinsic pathway
  - Developed for monitoring coumadin therapy
- Partial thromboplastin time (PTT) measures intrinsic pathway
  - Developed for monitoring heparin therapy and hemophilia
- We have ADAPTED these studies to test for coagulopathy of trauma
- And that's only half the story….

Platelets

- After the coagulation cascade lays down a fibrin “scaffolding”, platelets form the actual clot
- We don’t really have a good test of platelet function
  - We can look at platelet count to determine the NUMBER of platelets, but this doesn’t test the FUNCTION
  - We have platelet function tests that can look for the effects of aspirin and Plavix – but you have to know to look for them! These tests are also costly and take a long time for results.

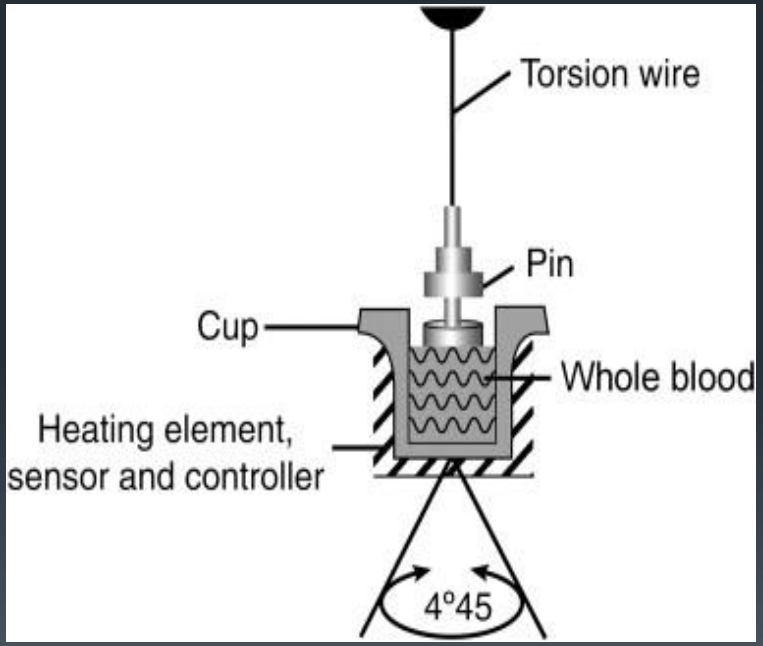
Thromboelastography

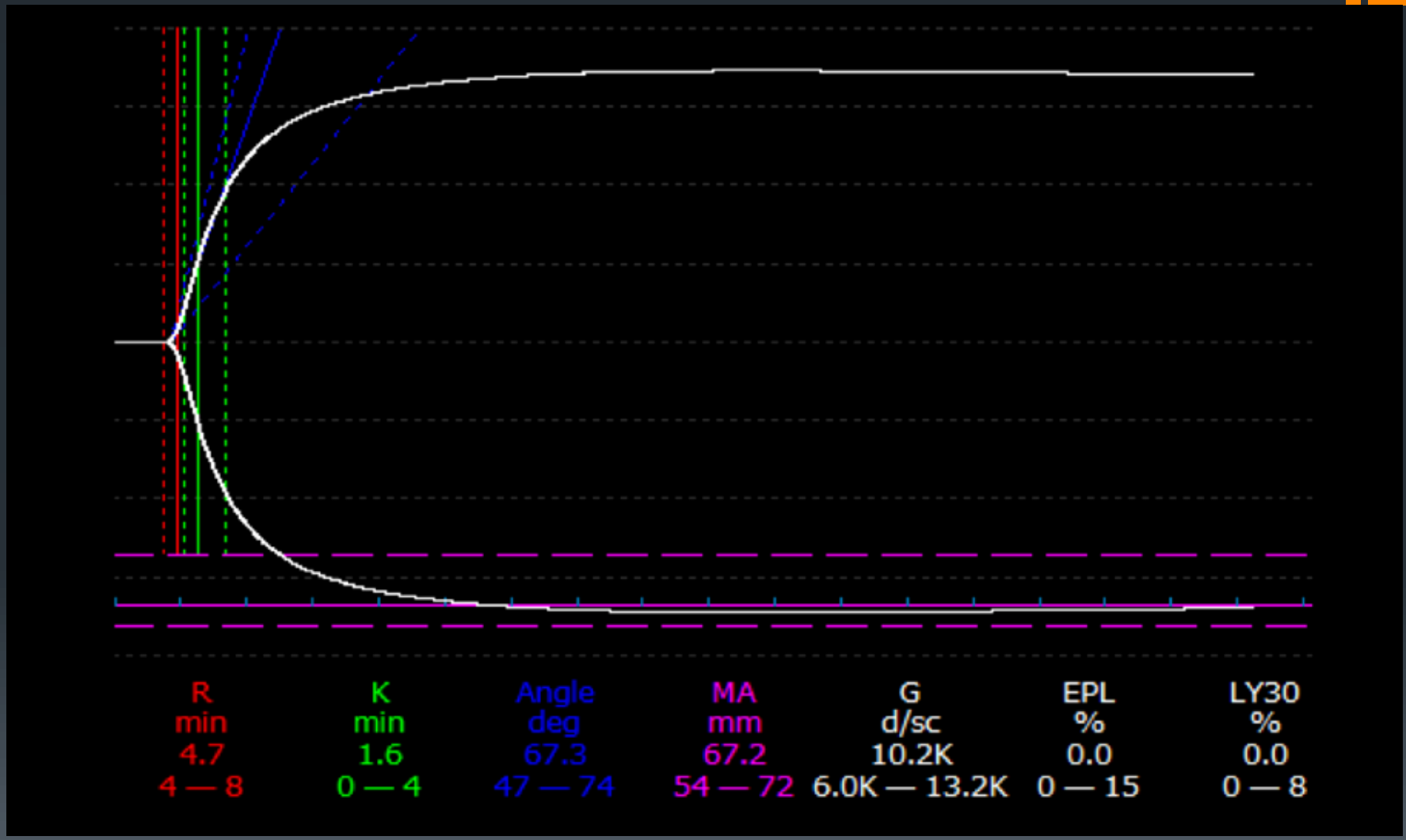
- Thromboelastography (TEG) is a test that looks at whole blood coagulation
- TEG is not new technology – it has been around for over 50 years
- It has been used for over 20 years in transplant and cardiac surgery
- Recently there has been considerable interest and research into using TEG for trauma patients

TEG 5000 Machine

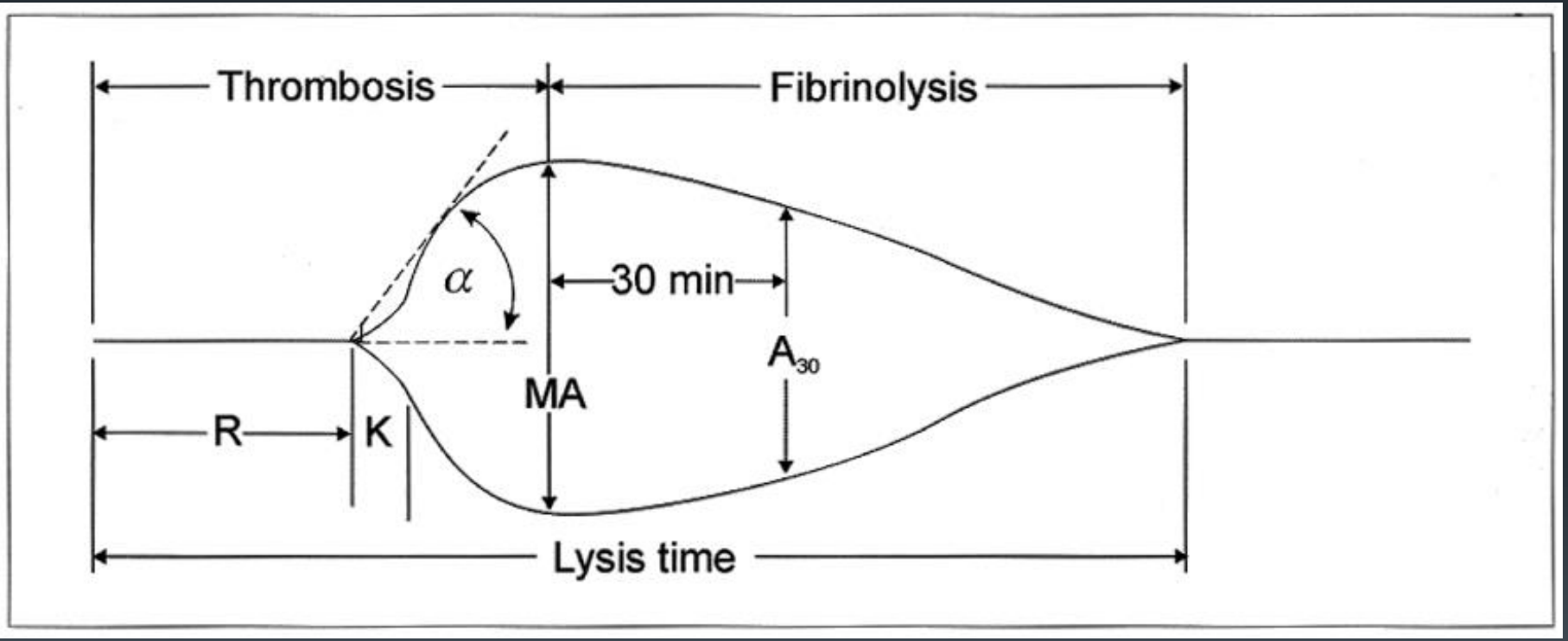
How it works

1. Whole blood is placed into the cup for analysis
2. An agent is added to start the coagulation cascade
3. The cup rotates
4. The pin senses the formation of the clot
5. Clot formation is displayed in a graph



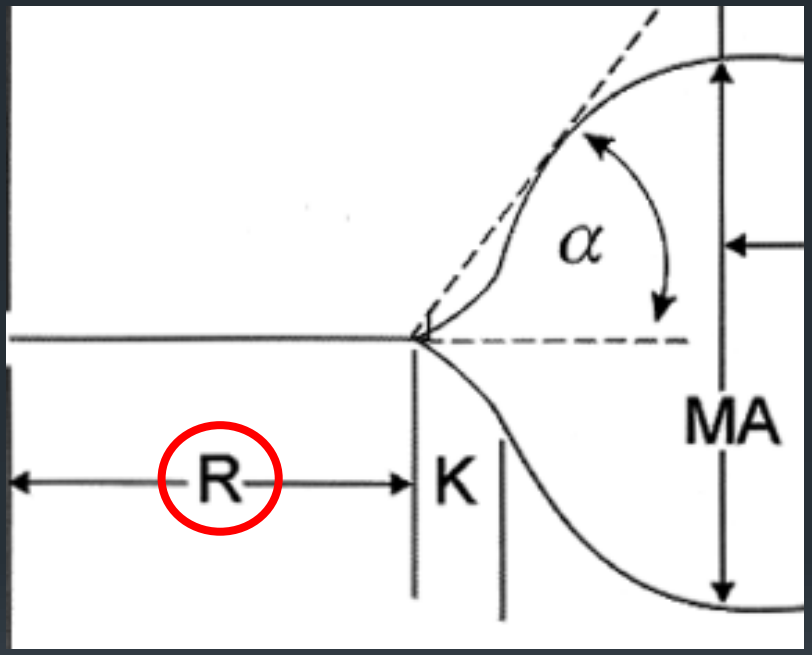

R
min
4.7
4 — 8
K
min
1.6
0 — 4
Angle
deg
67.3
47 — 74
MA
mm
67.2
54 — 72
G
d/sc
10.2K
6.0K — 13.2K
EPL
%
0.0
0 — 15
LY30
%
0.0
0 — 8

How do we interpret this?



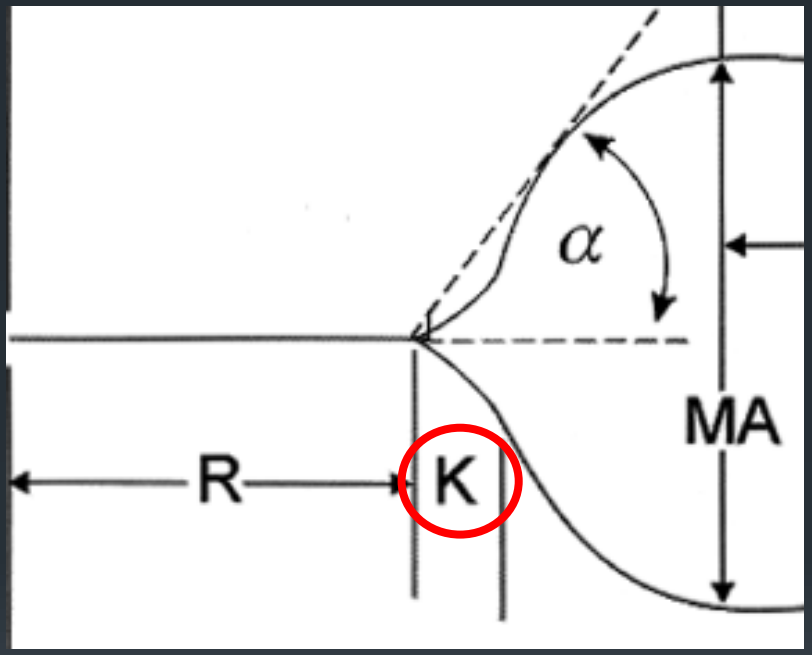
R-time

- “Reaction time” until initial clot forms
- This is like a PT or PTT
- If the R-time is INCREASED (meaning it is taking too long for clot to form), the patient needs FFP



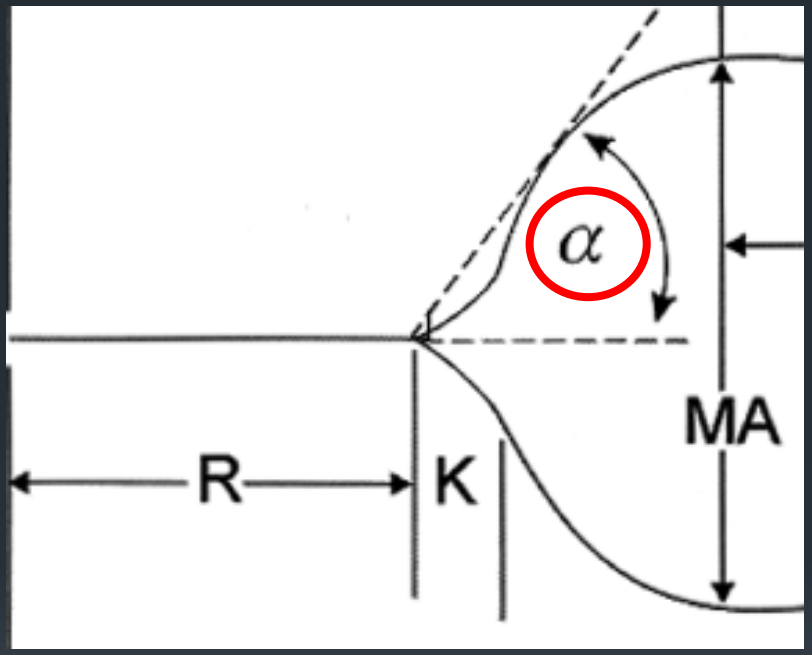
K-time

- “Kinetic time” for clot to reach 20 mm
- Reflects fibrinogen and platelet levels
- If the K-time is INCREASED, the patient may need cryoprecipitate or platelets



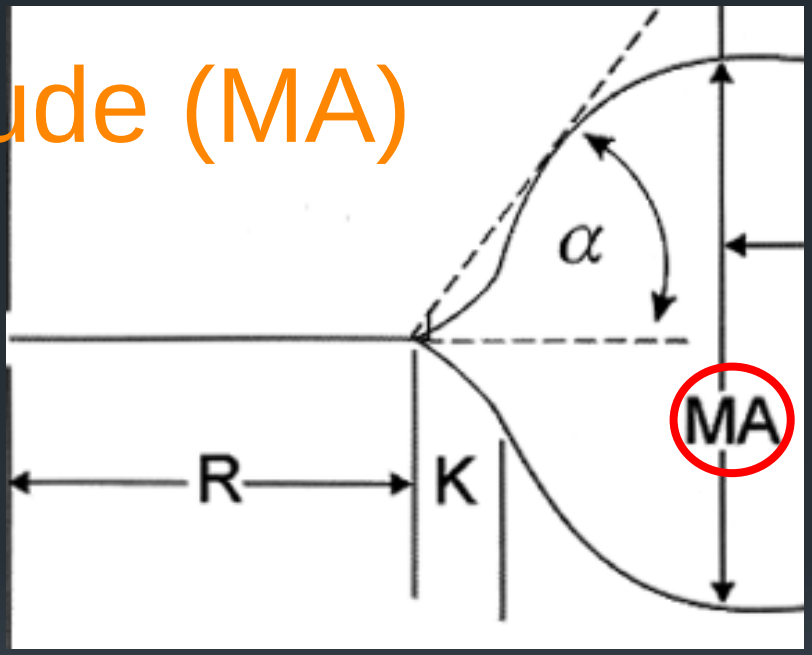
∝-angle

- Angle of slope which indicates speed of clot formation
- Reflects fibrinogen and platelet levels
- If DECREASED, the patient may need platelets or cryoprecipitate



Maximal Amplitude (MA)

- Maximum amplitude of tracing
- Reflects platelet contribution to clot strength
- If DECREASED, the patient has platelet dysfunction and needs platelets

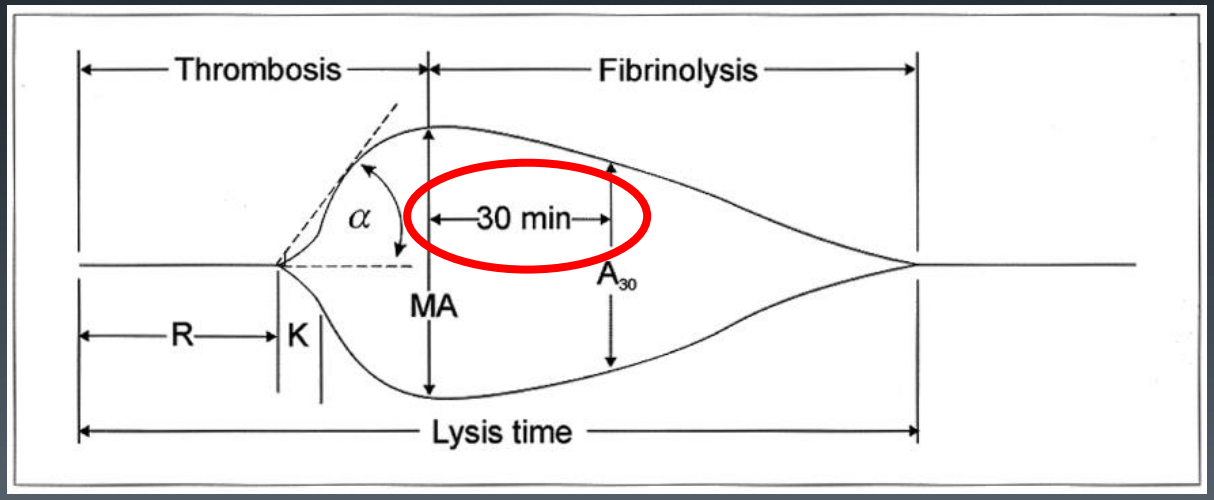


G-value

- Calculated value that measures absolute clot strength (both enzymatic and platelet contributions)
- G = (5000 x A) / (100 - A)
- Decreased in coagulopathic patients

LY-30

- Percentage of amplitude reduction 30 minutes after MA
- Elevated LY-30 means the clot is being broken down too rapidly, and the patient may benefit from tranexamic acid



TEG

- So as you can see, a TEG allows us to see how the patient's ENTIRE coagulation cascade is working
- This can help prevent unnecessary transfusion
- TEG may also pick up on coagulation abnormalities that aren't seen on conventional coagulation tests

Cost

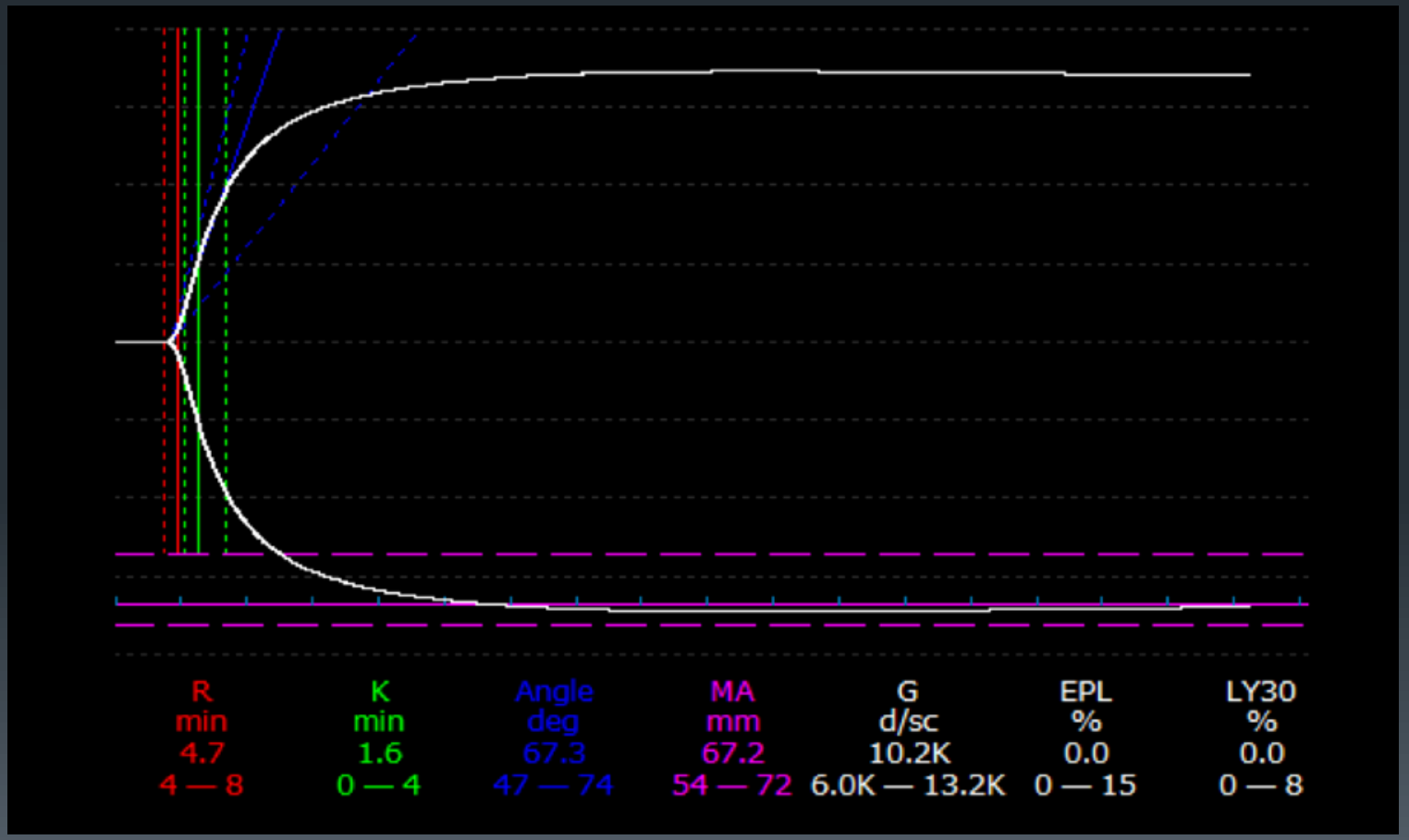
- TEG could potentially replace PT/INR, PTT, and platelet function tests
- Together, all of these tests cost over $500!
- A single TEG costs $225
- Potentially more savings if we can decrease utilization of blood products

What do the studies show?

- TEG is better than PT/INR and PTT in predicting need for transfusion in trauma patients (Holcomb et al, 2012)
- TEG guided resuscitation is superior to massive transfusion protocol in penetrating trauma (Tapia et al, 2012)
- TEG can predict need for transfusion faster than convential coagulation tests (Cotton et al, 2012)
- TEG can also show hypercoagulability and predict development of pulmonary embolism in trauma patients (Cotton et al, 2011)

EXAMPLES

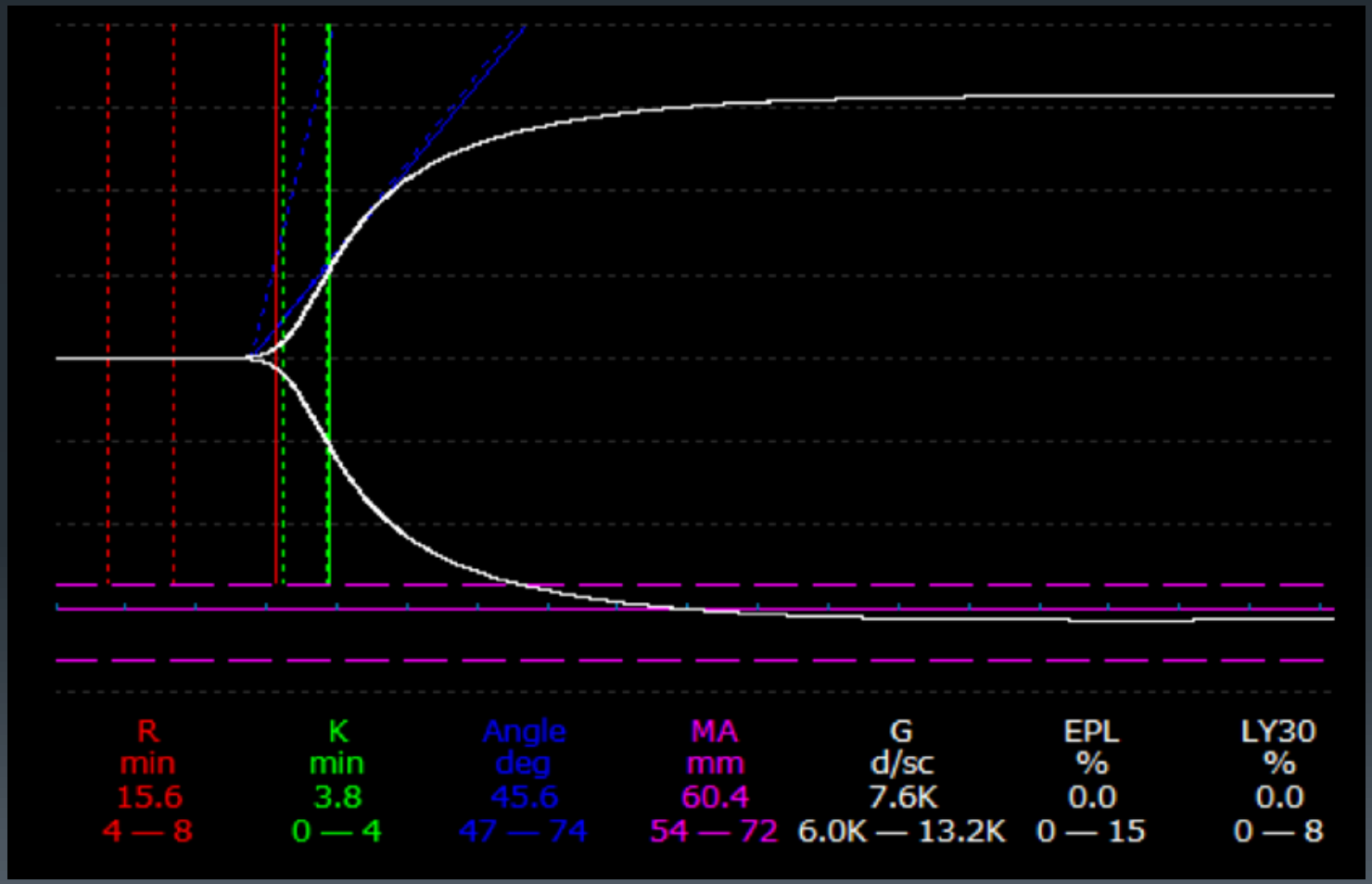
- A 19 year-old male presents as a trauma alert following a motorcycle crash. He is hypotensive and has a hemoglobin of 6.5 g/dL. A TEG is obtained in the trauma bay.



Case 1

- The TEG is normal.
- The patient needs transfusion of packed red blood cells and surgical correction of ongoing hemorrhage.
- In this case, we could potentially have prevented the patient from receiving unnecessary massive transfusion protocol.

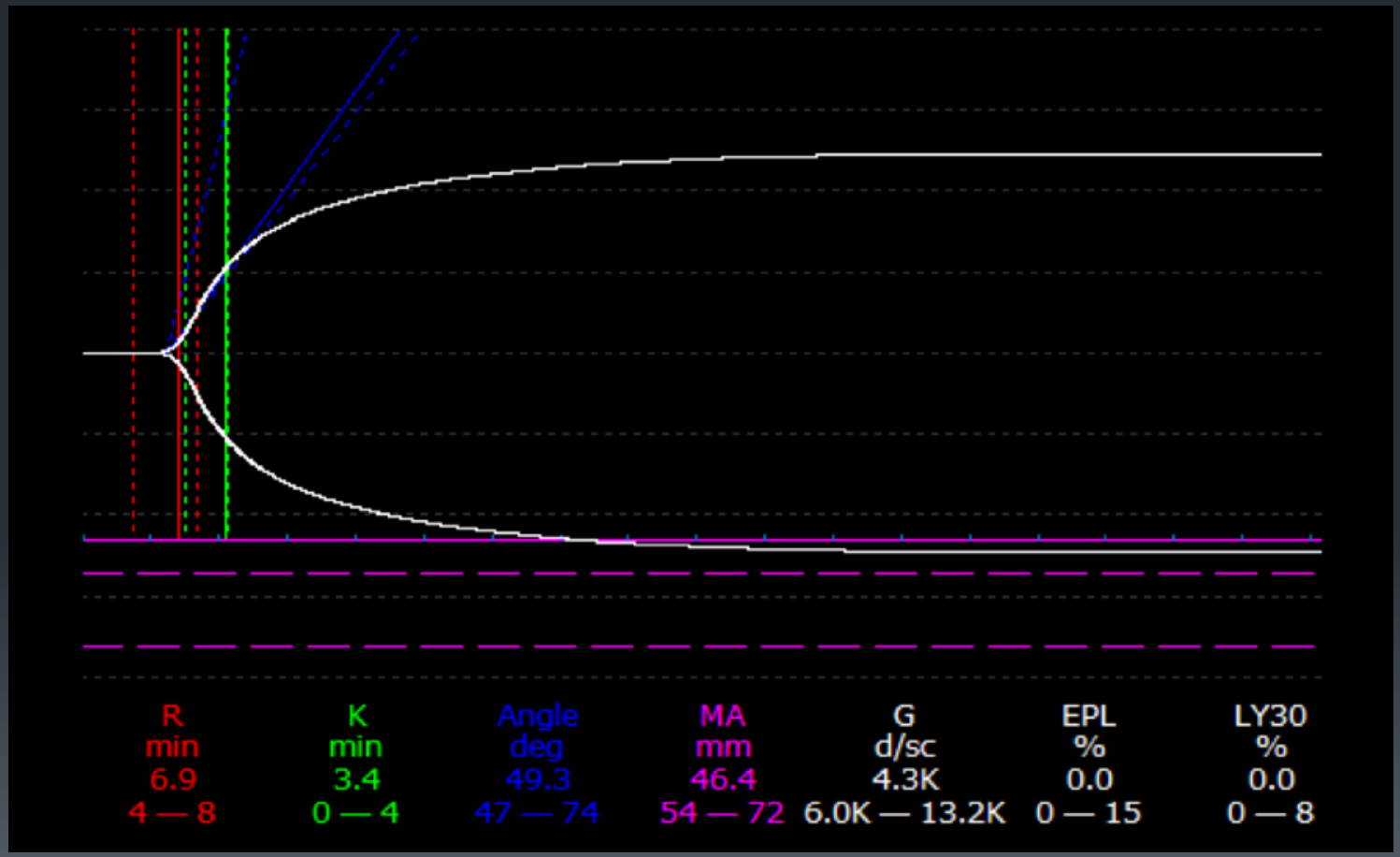
- A 65 year-old male presents as a trauma alert following a car crash. He is hemodynamically stable and has an admission Hgb of 10.0 g/dL. A TEG was obtained.



Case 2

- The patient has a prolonged r-time.
- This could indicate either an effect of an anticoagulant (such as coumadin) or coagulopathy of trauma.
- In either case, the patient needs a transfusion of fresh frozen plasma.

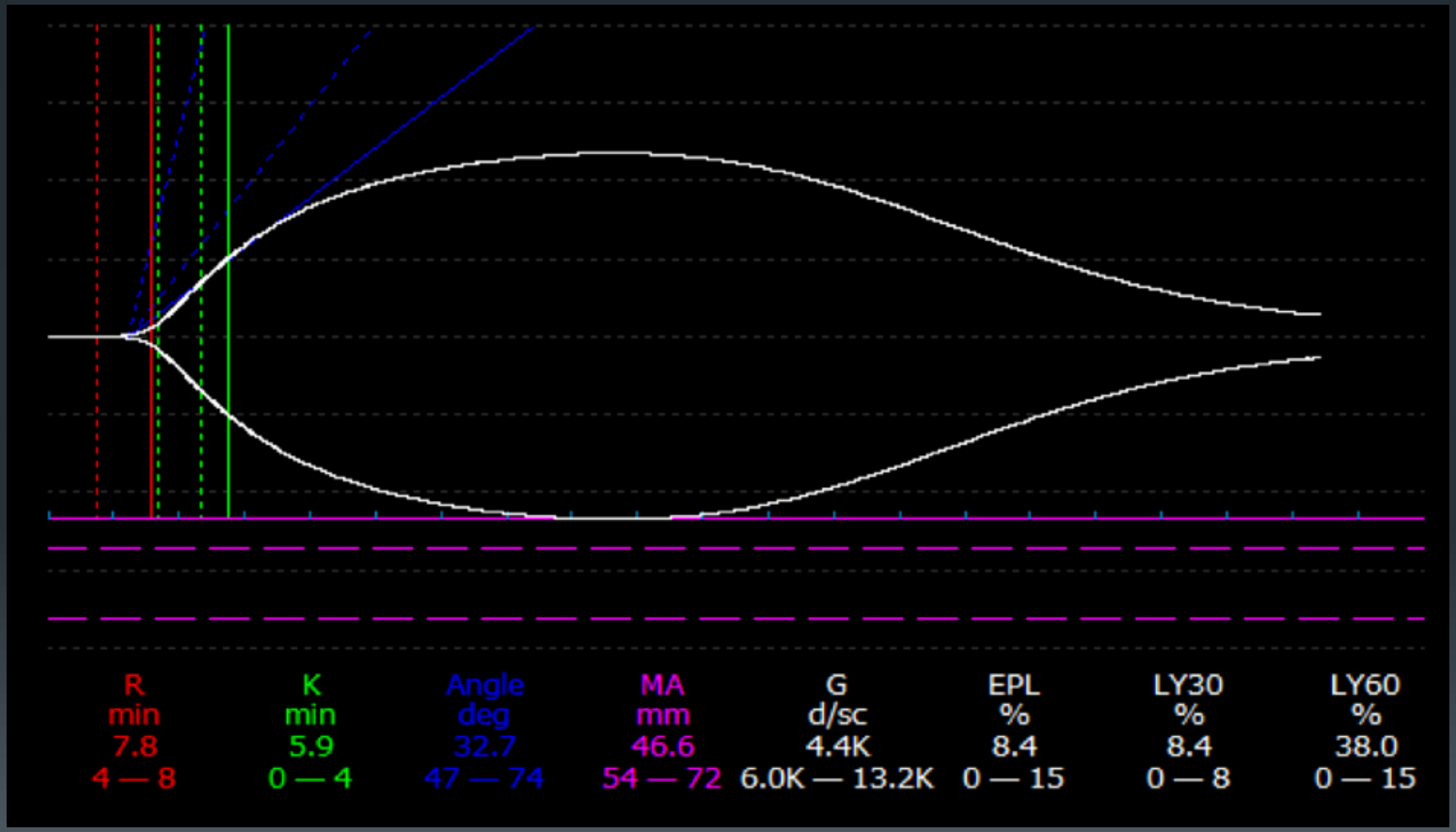
- A 70 year-old female with a history of coronary artery disease presented to the hospital after a fall and is found to have a subdural hemorrhage. A TEG was obtained on admission.



Case 3

- The MA is decreased.
- This indicates platelet dysfunction, likely from the effects of aspirin or Plavix in this patient with a history of CAD.
- The patient needs a platelet transfusion.

- A 25 year-old male presents as a trauma alert following GSW to the R chest. The patient is hypotensive and has a hemoglobin of 6.0 g/dL. After placing a chest tube, a TEG is obtained in the trauma bay.



Case 4

- The K-time, α-angle, and MA are all decreased.
- The patient requires at least platelets in addition to transfusion of pRBC’s.
- The r-time is at the upper limit of normal, so this patient would probably best benefit from MASSIVE TRANSFUSION PROTOCOL.
- Based on the elevated LY-30, this patient should also receive tranexamic acid.

In a nutshell…

TEG Result	Product to give
Increased r-time	FFP
Increased k-time	Cryoprecipitate ± platelets
Decreased α-angle	Platelets ± cryoprecipitate
Decreased MA	Platelets
Increased LY-30	Tranexamic acid

Summary

- TEG is a coagulation test that looks at the entire coagulation cascade
- TEG is not new technology but is newly being applied to the trauma population
- TEG may detect coagulopathies in trauma patients that aren’t picked up by conventional coagulation tests
- TEG can be used to guide blood product administration and thus potentially decrease utilization

Thank you for participating in this learning module!

Any questions???

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