16.50 Valutazione del profilo coagulativo perioperatorio

A. De Gasperi

monitoring haemostasis in surgical patients

- **preoperative testing**
  - to identify pts at increased risk for perioperative bleeding
- **intraoperative monitoring**
  - to identify pathological hemostatic changes in surgical procedures at risk
  - cardiac and vascular surgery
  - liver surgery
    - major resection
    - transplantation
  - orthopedic surgery (?)
  - trauma / trauma surgery
  - obstetric emergencies
- **postop monitoring**
  - bleeding tendency
  - tendency towards hypercoagulation

* Routine refers to a policy of performing a test or tests without regard to clinical indications in an individual patient.

† Screening means efforts to detect disease in unselected populations of asymptomatic patients.

[1] ASA Practice Advisory for Preanesthesia Evaluation: *Anesthesiology* 2002; 96:485-496. Amended in 2003 but not republished.

STATEMENT ON ROUTINE PREOPERATIVE LABORATORY AND DIAGNOSTIC SCREENING

Committee of Origin: Standards and Practice Parameters

(Approved by the ASA House of Delegates on October 15, 2003, and last amended on October 22, 2008)

Preoperative tests, as a component of the preanesthesia evaluation, may be indicated for various purposes, including but not limited to: 1) discovery or identification of a disease or disorder which may affect perioperative anesthetic care, 2) verification or assessment of an already known disease, disorder, medical or alternative therapy which may affect perioperative anesthetic care, and 3) formulation of specific plans and alternatives for perioperative anesthetic care. No routine* laboratory or diagnostic screening† test is necessary for the preanesthetic evaluation of patients. Appropriate indications for ordering tests include the identification of specific clinical indicators or risk factors (e.g., age, pre-existing disease, magnitude of the surgical procedure). This statement will be integrated into an update of the ASA Practice Advisory for Preanesthesia Evaluation[1] at a future date. It will not appear independently after that time.

Anesthesiologists, anesthesiology departments or health care facilities should develop appropriate guidelines for preanesthetic screening tests in selected populations after considering the probable contribution of each test to patient outcome. Individual anesthesiologists should order test(s) when, in their judgment, the results may influence decisions regarding risks and management of the anesthesia and surgery. Legal requirements for laboratory testing where they exist should be observed. The results of tests relevant to anesthetic management should be reviewed prior to initiation of the anesthetic. Relevant abnormalities should be noted and action taken, if appropriate.

bjh guideline

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures

British Journal of Haematology, **140**, 496–504

British Committee for Standards in Haematology

Y. L. Chee, [1] J. C. Crawford, [2] H. G. Watson[1] and M. Greaves[3]

Although some defend it as a means of avoiding litigation, it has been demonstrated that 30–95% of unexpected laboratory results from screening tests are either not documented or not pursued further (Muskett & McGreevy, 1986; Johnson & Mortimer, 2002). Therefore, random screening could potentially increase rather than reduce the risk of litigation.

bjh guideline

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures

British Journal of Haematology, **140**, 496–504

British Committee for Standards in Haematology

Y. L. Chee, [1] J. C. Crawford, [2] H. G. Watson[1] and M. Greaves[3]

Summary of key recommendations

1 Indiscriminate coagulation screening prior to surgery or other invasive procedures to predict postoperative bleeding in unselected patients is not recommended. (Grade B, Level III).

2 A bleeding history including detail of family history, previous excessive post-traumatic or postsurgical bleeding and use of anti-thrombotic drugs should be taken in all patients preoperatively and prior to invasive procedures. (Grade C, Level IV).

3 If the bleeding history is negative, no further coagulation testing is indicated. (Grade C, Level IV).

4 If the bleeding history is positive or there is a clear clinical indication (e.g. liver disease), a comprehensive assessment, guided by the clinical features is required. (Grade C, Level IV).

bjh guideline

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures

British Committee for Standards in Haematology

Y. L. Chee, [1] J. C. Crawford, [2] H. G. Watson[1] and M. Greaves[3]

British Journal of Haematology, 140, 496–504

bjh guideline

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures

British Journal of Haematology, **140**, 496–504

British Committee for Standards in Haematology

Y. L. Chee,[1] J. C. Crawford,[2] H. G. Watson[1] and M. Greaves[3]

By targeting a subgroup of patients with a positive bleeding history for further assessment and coagulation testing, it is plausible that the PV of the combination of an abnormal bleeding history and abnormal coagulation test may be higher for postintervention bleeding than either alone. Importantly, this strategy would enable testing to be focused on the minority of subjects in whom there is reasonable suspicion of the presence of a bleeding disorder.

e published data considered in this guideline indicate that an unstructured bleeding history is not a good predictor of postoperative bleeding (Grade B, level III) there are indications that a structured approach may be predictive. Therefore there is insufficient evidence to conclude that the bleeding history has no PV for postoperative bleeding. A bleeding history, including family history, evidence of excessive post-traumatic or postsurgical bleeding and use of antithrombotic drugs should be taken in all patients prior to surgery or invasive procedures. (Grade C, Level IV).

Preoperative evaluation of the adult patient undergoing non-cardiac surgery: guidelines from the European Society of Anaesthesiology

Stefan De Hert, Georgina Imberger, John Carlisle, Pierre Diemunsch, Gerhard Fritsch, Iain Moppett, Maurizio Solca, Sven Staender, Frank Wappler and Andrew Smith, the Task Force on Preoperative Evaluation of the Adult Noncardiac Surgery Patient of the European Society of Anaesthesiology

Coagulation disorders

Introduction

This section addresses the problem of patients with a potential coagulation disorder. This does not include the question of how to screen for coagulation disorders.

Eur J Anaesthesiol 2011;28:684–722

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Preoperative evaluation of the adult patient undergoing non-cardiac surgery: guidelines from the European Society of Anaesthesiology

Stefan De Hert, Georgina Imberger, John Carlisle, Pierre Diemunsch, Gerhard Fritsch, Iain Moppett, Maurizio Solca, Sven Staender, Frank Wappler and Andrew Smith, the Task Force on Preoperative Evaluation of the Adult Noncardiac Surgery Patient of the European Society of Anaesthesiology

Recommendations

2+	Well conducted case–control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2–	Case–control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytical studies (case reports, case series, etc.)
4	Expert opinion

(3) Routine use of coagulation tests is not recommended unless there are specific risk factors in the history (grade of recommendation: D).

D	Evidence level 3 or 4 or extrapolated evidence from studies rated as 2+

Eur J Anaesthesiol 2011;28:684–722

Published online 14 September 2011

Preoperative tests

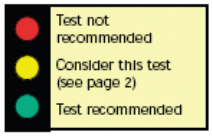
The use of routine preoperative tests for elective surgery

Grade 2 surgery (intermediate)

Grade 2 surgery *continued*

ASA Grade 2: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40	40 to < 60	60 to < 80	≥ 80
Chest X-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases	No	No	No	No
Lung function	No	No	No	No



ASA Grade 3: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40	40 to < 60	60 to < 80	≥ 80
Chest X-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count				
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

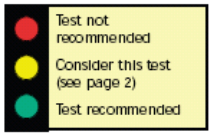
See pages 3–4 for more information.

Grade 2 surgery (intermediate)

Grade 2 surgery *continued*

ASA Grade 2: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40	40 to < 60	60 to < 80	≥ 80
Chest X-ray				
ECG	No			
Full blood count				
Haemostasis	No	No	No	No
Renal function	No			
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No



ASA Grade 3: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40	40 to < 60	60 to < 80	≥ 80
Chest X-ray				
ECG			Yes	Yes
Full blood count				Yes
Haemostasis	No	No	No	No
Renal function				
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

Preoperative tests

The use of routine preoperative tests for elective surgery

Grade 3 surgery (major)

Grade 3 surgery *continued*

ASA Grade 2: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	≥ 80 N
Chest X-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 3: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	≥ 80 N
Chest X-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

Grade 3 surgery (major)

Grade 3 surgery *continued*

ASA Grade 2: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	≥ 80 N
Chest X-ray				
ECG				Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function			Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No			

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 3: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	≥ 80 N
Chest X-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis	No	No	No	No
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

NHS National Institute for Clinical Excellence

Clinical Guideline 3
June 2003

Preoperative tests

The use of routine preoperative tests for elective surgery

Grade 4 surgery (major+)

Grade 4 surgery *continued*

ASA Grade 2: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray				
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 3: adults with comorbidity from **cardiovascular disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray			Yes	Yes
ECG	Yes	Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function	No	No	No	No

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

Grade 4 surgery (major+)

Grade 4 surgery *continued*

ASA Grade 2: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray				
ECG			Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No
Urine analysis				
Blood gases				
Lung function				

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 3: adults with comorbidity from **respiratory disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function				

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

NHS National Institute for Clinical Excellence

Clinical Guideline 3
June 2003

Preoperative tests

The use of routine preoperative tests for elective surgery

Grade 4 surgery (major+)

Grade 4 surgery *continued*

ASA Grade 2: adults with comorbidity from **renal disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray				
ECG†		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

†Depending on the cause of renal disease (e.g. diabetes and hypertension)

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 3: adults with comorbidity from **renal disease**

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	80 N
Chest X-ray				
ECG		Yes	Yes	Yes
Full blood count	Yes	Yes	Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis				
Blood gases				
Lung function	No	No	No	No

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

Neurosurgery

Neurosurgery

ASA Grade 1: children < 16 years

Test	Age < 6 months	≥ 6 to < 12 months	≥ 1 to < 5 years	≥ 5 to < 12 years	≥ 12 to < 16 years
Chest X-ray	No	No	No	No	No
ECG	No	No	No	No	No
Full blood count					
Haemostasis					
Renal function	Yes	Yes	Yes	Yes	Yes
Random glucose	No	No	No	No	No
Urine analysis*					

*Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

Test not recommended
Consider this test (see page 2)
Test recommended

ASA Grade 1: adults ≥ 16 years

Test	Age (years) 16 to < 40 N	40 to < 60 N	60 to < 80 N	≥ 80 N
Chest X-ray	No	No		
ECG			Yes	Yes
Full blood count			Yes	Yes
Haemostasis				
Renal function	Yes	Yes	Yes	Yes
Random glucose				
Urine analysis*				

*Dipstick urine testing in asymptomatic individuals is not recommended (UK National Screening Committee)

ASA Grades

Grade 1 Normal healthy patient (i.e. without any clinically important comorbidity and without a clinically significant past/present medical history).

Grade 2 Patient with mild systemic disease.

Grade 3 A patient with severe systemic disease but the disease is not a constant threat to life.

See pages 3–4 for more information.

ICSI
INSTITUTE FOR CLINICAL SYSTEMS IMPROVEMENT
Health Care Guideline:
Preoperative Evaluation
Ninth Edition
June 2010

Algorithm Annotations

Coagulation Studies

There is no evidence to support routine checking of coagulation studies unless clinical circumstances suggest a potential bleeding problem. This is because of the low sensitivity and lack of predictive value of these tests *(Asaf, 2001 [C])*.

Coagulation studies	• Patient has a known history of coagulation abnormalities or recent history suggesting coagulation problems or is on anticoagulants.
	• Patient needs anticoagulation post-operatively (where a baseline may be needed).
Hemoglobin	• Patient has a history of anemia or history suggesting recent blood loss or anemia.

ASSETTO EMOCOAGULATIVO:		
	Pazienti	Raccomandazione
ASA 1	grado di chirurgia 1, 2, 3	non raccomandato
	grado di chirurgia 4	non raccomandato < 16 anni da considerare > 16 anni
	neurochirurgia	da considerare sempre
	cardiochirurgia	da considerare sempre
	in caso di: **chirurgia vascolare (per fornire un valore di base in cardiochirurgia o per pazienti chirurgici oncologici) o in pazienti che fanno uso di warfarin o altri anticoagulanti o in emodialisi**	**raccomandato A**
ASA 2	Malattia Cardiovascolare	
	grado di chirurgia 1, 2, 3	non raccomandato
	grado di chirurgia 4	da considerare sempre
ASA 3	Malattia Cardiovascolare	
	grado di chirurgia 1, 2	non raccomandato
	grado di chirurgia 3, 4	da considerare sempre
ASA 2	Patologia Polmonare	
	grado di chirurgia 1, 2, 3	non raccomandato
	grado di chirurgia 4	da considerare sempre
ASA 3	Patologia Polmonare	
	grado di chirurgia 1, 2, 3	non raccomandato
	grado di chirurgia 4	da considerare sempre
ASA 2	Patologia Renale	
	grado di chirurgia 1, 2	non raccomandato
	grado di chirurgia 3, 4	da considerare sempre
ASA 3	Patologia Renale	
	grado di chirurgia 1, 2, 3, 4	da considerare sempre

Valutazione preoperatoria del paziente da sottoporre a chirurgia elettiva

Linee guida nazionali di riferimento

- **Assetto emocoagulativo**
  Anomalie rilevate: 0,4%-45,9% dei pazienti.
  Modificazione del management clinico: 0%-7,3% dei pazienti.
  Comparsa di complicanze post-operatorie: 0%-8,1% dei pazienti.

Preoperative evaluation of the adult patient undergoing non-cardiac surgery: guidelines from the European Society of Anaesthesiology

Stefan De Hert, Georgina Imberger, John Carlisle, Pierre Diemunsch, Gerhard Fritsch, Iain Moppett, Maurizio Solca, Sven Staender, Frank Wappler and Andrew Smith, the Task Force on Preoperative Evaluation of the Adult Noncardiac Surgery Patient of the European Society of Anaesthesiology

Recommendations

(1) If coagulation disorders are suspected, the patient should be referred to a haematologist (grade of recommendation: D).

(2) Preoperative correction of haemostasis decreases perioperative bleeding (grade of recommendation: D).

(3) Routine use of coagulation tests is not recommended unless there are specific risk factors in the history (grade of recommendation: D).

D	Evidence level 3 or 4 or extrapolated evidence from studies rated as 2+

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doi:10.1093/bja/aeq357

EDITORIAL I

Routine preoperative coagulation tests: an outdated practice?

J. J. van Veen[1], D. R. Spahn[2] and M. Makris[1*]

that a structured bleeding history is taken and coagulation testing is undertaken only if there is concern about a bleeding tendency arising from the history. This may then also include referral to haematology to investigate disorders that are not detected by routine testing.

Therefore,

In conclusion, we feel that indiscriminate use of routine coagulation testing in the preoperative setting is not helpful and may cause unnecessary further testing and delay of surgery. Coagulation testing should be restricted to well-defined circumstances:

approach to

Testing, however, should be considered in patients with acute conditions potentially associated with a haemorrhagic tendency such as liver disease, sepsis, diffuse intravascular coagulation, pre-eclampsia, cholestasis, and poor nutritional states leading to vitamin K deficiency.

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Assessment of the bleeding history, including a physical examination, is still considered the best tool for identification of patients with impaired haemostasis and/or an increased risk of bleeding complications during and after surgery. Platelet dysfunctions are the most common defects of haemostasis, occurring in up to 5% of patients undergoing surgery. When a coagulation disorder is suspected based on the patient's history and/or clinical examination, further haematological assessment of the condition is warranted.

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doi:10.1093/bja/aeq357

EDITORIAL I

Routine preoperative coagulation tests: an outdated practice?

J. J. van Veen[1], D. R. Spahn[2] and M. Makris[1*]

Finally, there is increasing interest in the possibility of perioperative monitoring of the effect of antiplatelet agents such as aspirin and clopidogrel. Although various point-of-care tests have been developed, there remain significant questions about their sensitivity, specificity, and ability to predict bleeding,[17] and none of these tests are therefore currently routinely recommended in the preoperative setting but are the subject of ongoing studies.

Laboratory assessment and perioperative management of patients on antiplatelet therapy: From the bench to the bedside

Giuseppe Lippi [a,*], Emmanuel J. Favaloro [b], Gian Luca Salvagno [a], Massimo Franchini [c]

Table 1
Laboratory tests used to assess primary hemostat

Bleeding time test
Platelet (light transmission) and whole blood (in
Platelet function screening tests
- Platelet Function Analyzer-100® [PFA-100®, Siemens, Marburg, Germany]
- VerifyNow® [Accumetrics, Inc., San Diego, CA]
- Plateletworks® [Helena Biosciences, Beaumont, Texas]
- Hemostatus® [Medtronic, Parker, Colorado]
Flow cytometry
Thromboelastography
- Platelet Mapping® (Haemoscope, Niles, IL, USA)
- Sonoclot® (Sienco, Inc., Morrison, CO, USA)

3.3. Platelet function analyzer-100

Due to the rapidity, ease of use and favorable diagnostic performances, the platelet function analyzer-100 (PFA-100) is the most widely used compact analyzer for identifying disorders of primary hemostasis worldwide, being recently licensed by the US Food and Drug Administration (FDA) for this application [50,51]. The PFA-100 simulates the process of platelet adhesion and aggregation triggered by either collagen/epinephrine (CEPI) or collagen/ADP (CADP) in vitro, reporting results as a "closure time" (CT). Although the test would be seem ideally suited for monitoring platelet inhibition by several antiplatelet agents and for identifying aspirin-resistance [28], there are several factors that compromise the effectiveness of the PFA-100 in this setting. For the PFA-100, a prolongation

Clinica Chimica Acta 405 (2009) 8–16

monitoring haemostasis in surgical patients

- **preoperative testing**
  - to identify pts at increased risk for perioperative bleeding
- **intraoperative monitoring**
  - to identify pathological hemostatic changes in surgical procedures at risk
  - cardiac and vascular surgery
  - liver surgery
    - major resection
    - transplantation
  - orthopedic surgery (?)
  - trauma / trauma surgery
  - obstetric emergencies
- **postop monitoring**
  - bleeding tendency
  - tendency towards hypercoagulation

perdite ematiche nella chirurgia maggiore: come influenzarle

- riduzione di perdite ematiche e di entità trasfusionale
  - miglioramento delle tecniche chirurgiche
    - approccio chirurgico
    - innovazioni tecnologiche
  - migliore comprensione modificazioni del profilo fisiologico perioperatorio
    - monitoraggio
    - terapia sostitutiva
    - manipolazione farmacologica

monitoraggio : le finalità

- identificazione del problema
- diagnosi differenziale
- guida al trattamento
- conferma dell'effetto della terapia

the ideal test for the perioperative coagulation profile

- simple to perform
- accurate
- reproducible
- reliable
- diagnostically specific
- cost-effective

emostasi: monitoraggio clinico

- laboratorio
  - conta piastrinica
  - PT aPTT TT TR
  - Fibrinogeno
  - FDP / d-Dimero
  - ATIII (?)

But .....

- conventional laboratory assessment of coagulation takes time.
- 30 to 60 minutes lag time required for results of PT / aPTT

Vox Sanguinis (2003) 84, 251–255

REVIEW ARTICLE

Near–patient testing of haemostasis in the operating theatre: an approach to appropriate use of blood in surgery

C. M. Samama[1] & Y. Ozier[2]

[1]Department of Anaesthaesiology and Intensive Care, Hôpital Avicenne, Bobigny, France [2]Department of Anaesthaesiology and Intensive Care, Groupe Hospitalier Cochin 27, Paris, France

Activated partial thromboplastin time (aPTT) and prothrombin time (PT) are basic coagulation tests that are commonly used intraoperatively. In various clinical situations, especially when replacement of massive blood loss is needed, monitoring of the PT and aPTT is very helpful. A lengthening of the tests may be understood to be a consequence of haemodilution, but it also can be attributed to a consumption coagulopathy. Most current guidelines for blood-component therapy recommend measurement of the PT and aPTT to diagnose an intraoperatively acquired coagulopathy and to consider the need for transfusion with fresh-frozen plasma (FFP). Therefore, an immediately available result is critical for patient care.

Vox Sanguinis (2003) **84**, 251–255

REVIEW ARTICLE

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C. M. Samama[1] & Y. Ozier[2]

[1]*Department of Anaesthaesiology and Intensive Care, Hôpital Avicenne, Bobigny, France* [2]*Department of Anaesthaesiology and Intensive Care, Groupe Hospitalier Cochin 27, Paris, France*

- rapid detection and timely correction of haemostatic defects are the driving forces leading to the implementation of point-of-care (POC) testing of haemostasis in the operating theatre

Vox Sanguinis (2003) **84**, 251–255

REVIEW ARTICLE

Near–patient testing of haemostasis in the operating theatre: an approach to appropriate use of blood in surgery

C. M. Samama[1] & Y. Ozier[2]

[1]*Department of Anaesthaesiology and Intensive Care, Hôpital Avicenne, Bobigny, France* [2]*Department of Anaesthaesiology and Intensive Care, Groupe Hospitalier Cochin 27, Paris, France*

Real-time aPTT and PT undoubtedly would provide useful information for anaesthetists. A compact portable coagulation monitor (CoaguChekProDM® monitor, ex CoaguChek-plus®, and formerly Ciba Corning Biotrack 512 monitor; Roche Diagnostics, Mannheim, Germany) is available to perform instantaneous aPTT and PT, and several studies have been published [1–7,15,16]. Of note, this whole-blood technology cannot be strictly compared to conventional aPTT and PT performed on platelet-poor plasma. What you see is probably not exactly what you get. CoaguChek aPTT and PT results are not exactly laboratory aPTT and PT results.

the ideal test
for the perioperative coagulation profile

- no single monitoring device / test available with these characteristics
- many provide useful information to guide patient management

 combinations of these devices relevant to provide critical diagnostic insights

- the importance of *integrated monitoring* to define perioperative coagulation profile

Monitoring Intraoperative Coagulation

Transplantation Proceedings, 38, 815–817 (2006)

A. De Gasperi, O. Amici, E. Mazza, F. Garrone, A. Sciascia, and A. Corti

Instead of measuring the

single "static"
thrombin time
to "dynamical
formation to
boelastography

LABORATORY EVALUATION OF HEMOSTATIC FUNCTION

The ideal laboratory test to evaluate hemostasis in the bleeding surgical or medical patient should reflect the dynamic status of bleeding and be accurate and available in real time to enable the physician to make treatment decisions rapidly. Testing should be specific for different physiologic mechanisms to target

Vol. 110, No. 2, February 2010

Thromboelastography (TEG)

- ..the methods is of more clinical relevance during surgery than a limited series of tests who looks only at the first stages of clot formation..
- as with any form of monitoring, decision regarding therapeutic intervention should always be based *on clinical ground in addition to the results of the tests*

Mallett SV, Cox JA: *Thrombelastogr Br J Anaest* 1992; 69:307–313

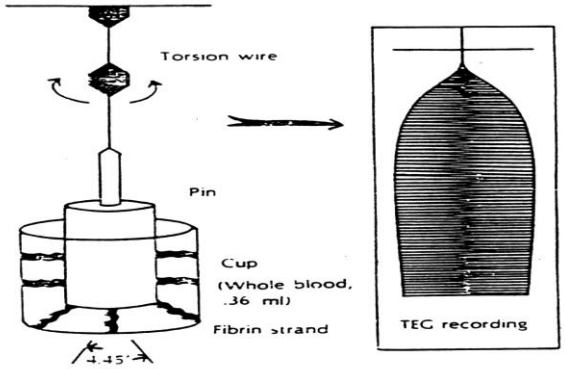
- The patterns of changes in shear-elasticity enable
  - the determination of the kinetics of clot formation and growth
  - the strength and stability of the formed clot
  - the strength and stability of the clot provides information about the ability of the clot to perform the work of hemostasis
  - the kinetics determine the adequacy of quantitative factors available to clot formation

- J Chir (Paris). 1958 Oct;76(3):

- **Data obtained from thromboelastography in the study of blood hypercoagulability in surgical patients.**

  DE HAYNIN G, WITZ JP, BOURGON, WEISS AG.

  PMID: 13587597
- [PubMed - OLDMEDLINE for Pre1966]



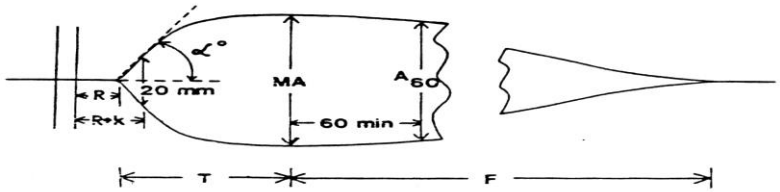
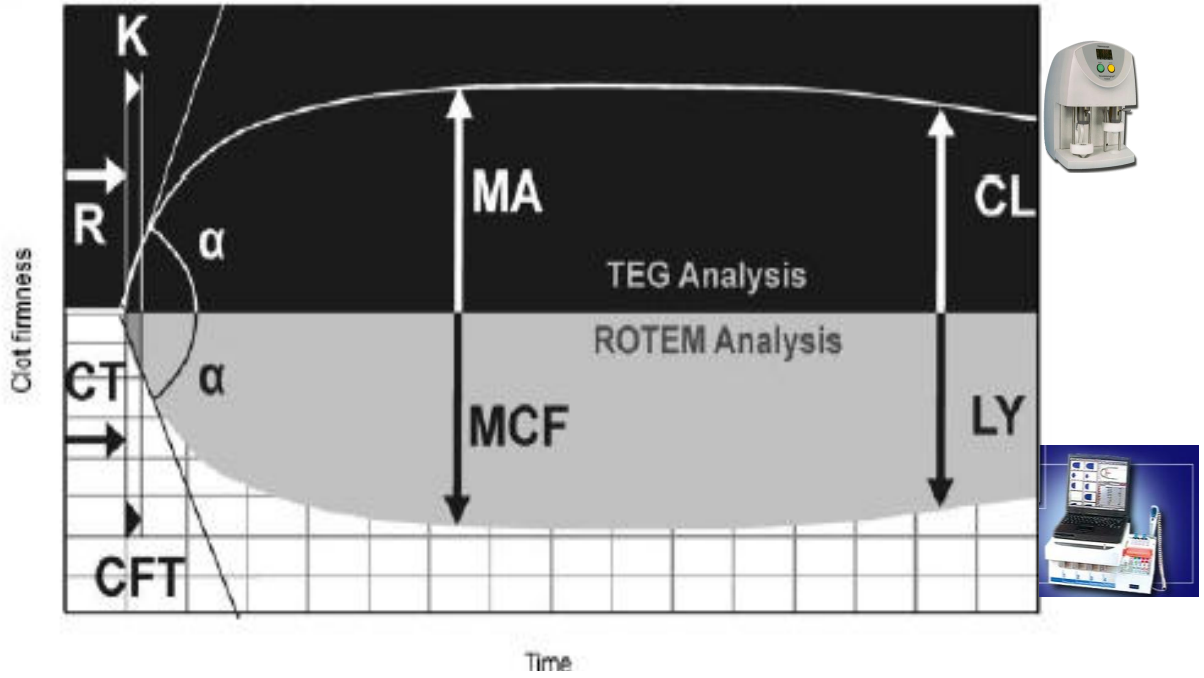


Table 2. Nomenclature and Reference Values of Thrombelastography (TEG®) and Thrombelastometry (ROTEM®)

	TEG®	ROTEM®
Clotting time (period to 2 mm amplitude)	*R* (reaction time) *N* (WB) 4–8 min *N* (Cit, kaolin) 3–8 min	CT (clotting time) *N* (Cit, in-TEM) 137–246 s *N* (Cit, ex-TEM) 42–74 s
Clot kinetics (period from 2 to 20 mm amplitude)	*K* (kinetics) *N* (WB) 1–4 min *N* (Cit, kaolin) 1–3 min	CFT (clot formation time) *N* (Cit, in-TEM) 40–100 s *N* (Cit, ex-TEM) 46–148 s
Clot strengthening (alpha angle)	α (slope between r and k) *N* (WB) 47°–74° *N* (Cit, kaolin) 55°–78°	α (slope of tangent at 2 mm amplitude) *N* (Cit, in-TEM) 71°–82° *N* (Cit, ex-TEM) 63°–81°
Amplitude (at set time) Maximum strength	*A* MA (maximum amplitude) *N* (WB) 55–73 mm *N* (Cit, kaolin) 51–69 mm	*A* MCF (maximum clot firmness) *N* (Cit, in-TEM) 52–72 mm *N* (Cit, ex-TEM) 49–71 mm *N* (Cit, fib-TEM) 9–25 mm
Lysis (at fixed time)	CL30, CL60	LY30, LY60

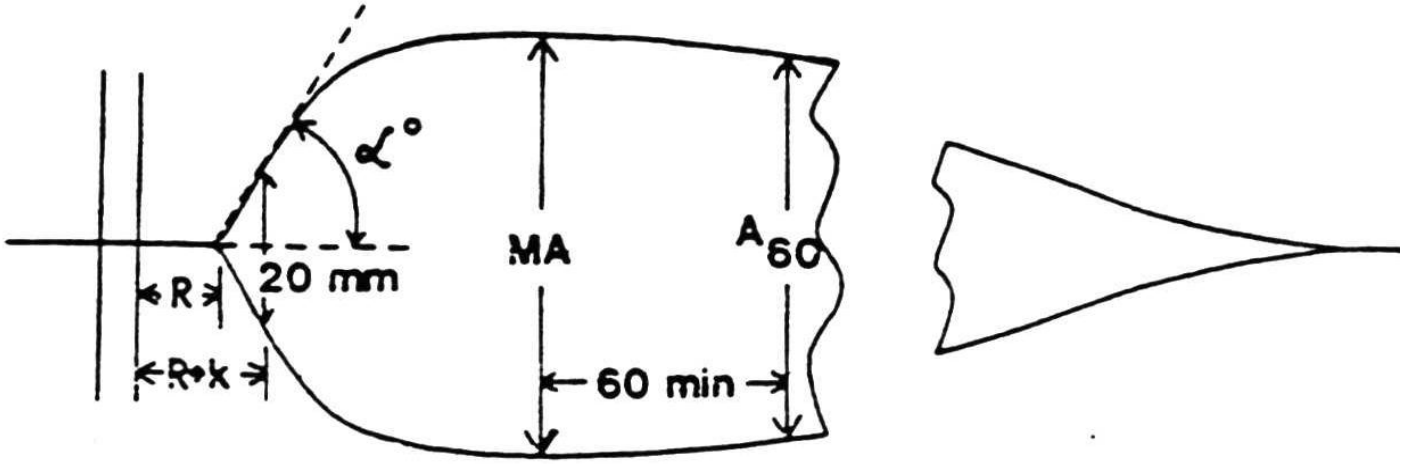


Coagulation Monitoring: Current Techniques and Clinical Use of Viscoelastic Point-of-Care Coagulation Devices

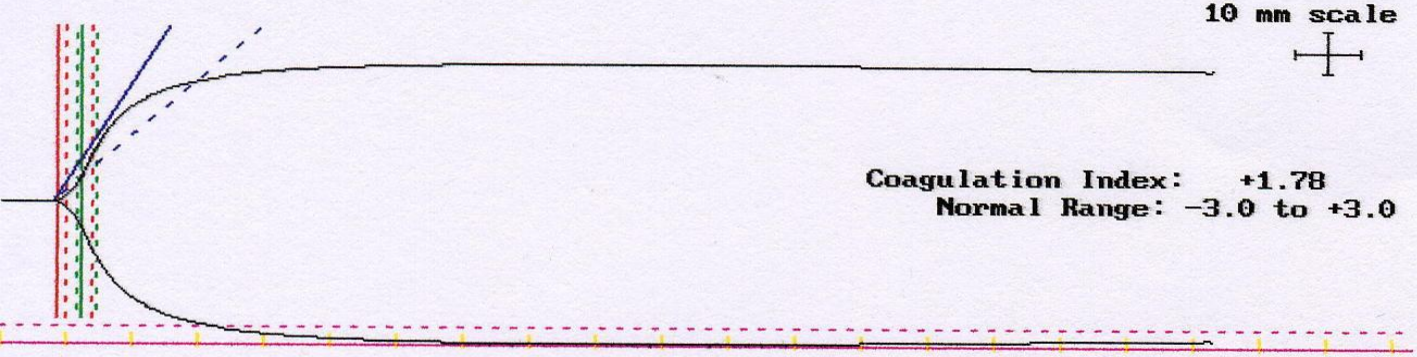
(Anesth Analg 2008;106:1366–75)

Michael T. Ganter, MD*
Christoph K. Hofer, MD†

Perioperative monitoring of blood coagulation is critical to better understand causes of hemorrhage, to guide hemostatic therapies, and to predict the risk of bleeding during the consecutive anesthetic or surgical procedures. Point-of-care (POC) coagulation monitoring devices assessing the viscoelastic properties of



Time On
Pat.ID
Sample

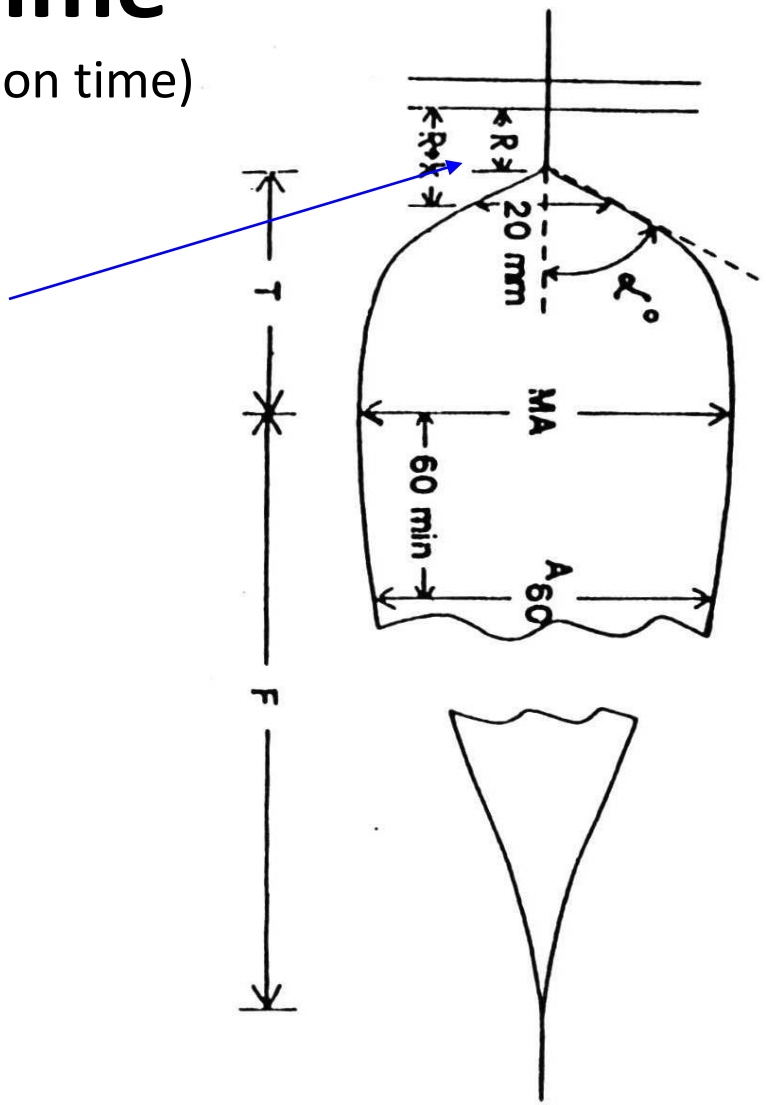


SP	R	K	ANG	MA	TMA	G	EPL	CL30
mm	mm	mm	deg	mm	sec	d/sc	%	%
8.1	8.8	3.8	67.0	66.0	1492.0	9705.9	0.0	100.0
	10-14	3-6	53-67	59-68		7195-10625		

R time

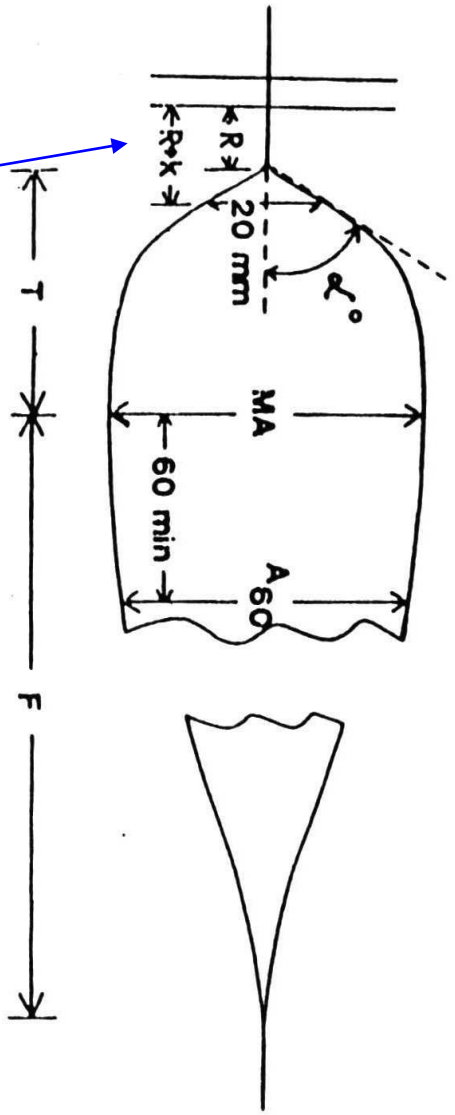
(reaction time)

- **R time** 6 – 8 min
  - initiation of the test to the initial fibrin formation
    - intrinsec pathw
- correlated with
  - coagulation factors
  - aPTT
- changes
  - Long R
    - anticoagulants
    - Coagulation factors **deficit**
  - Short R
    - Hypercoagulation



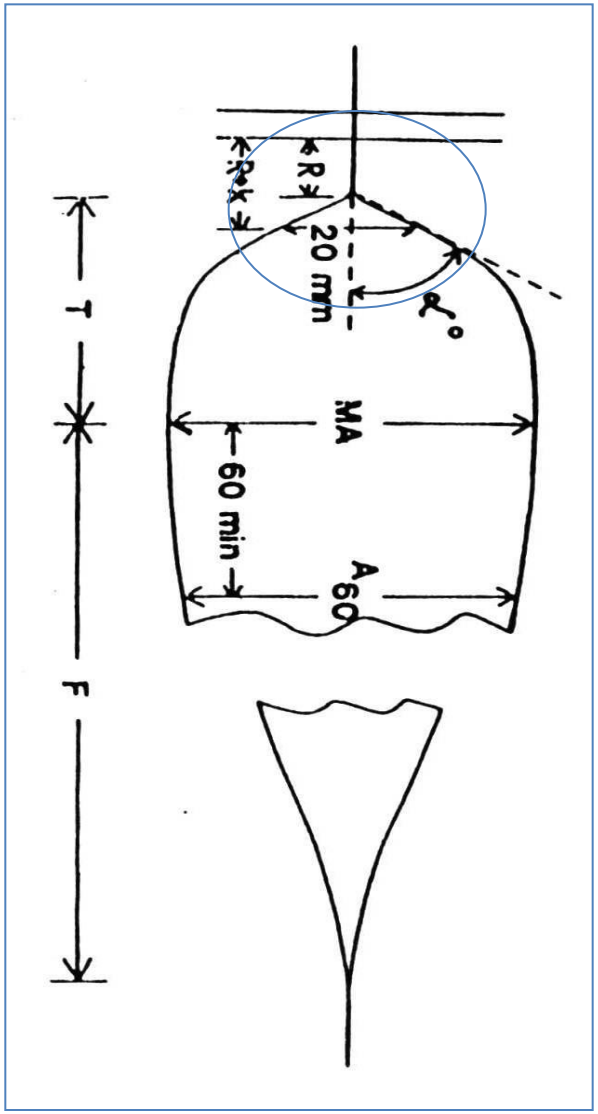
K time

- **K time** (reaction time)
  - 2 – 4 min
    - from beginning of clot formation until TEG amplitude reaches 20 mm, (dynamics of clot formation)
- correlated with
  - **fibrinogen**
  - **PLT**
- long K
  - anticoagulants
  - Fibrinogen deficit
- short K
  - Increased fibrinogen level improve dPLT function



α angle

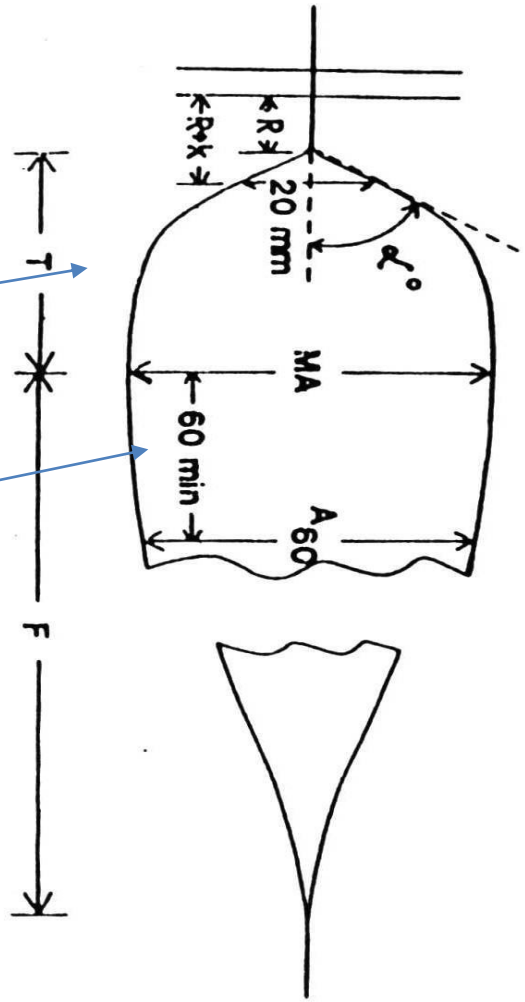
- α angle (Clot formation rate)
- >50°
- angle between the line in the middle of thromboelastogram and the line tangential to the developing "body" of the thombelastogram.
- acceleration (kinetics) of fibrin build up and cross-linking.
  - **Fibrinogen**
  - PLT
- Reduced
  - Fibrinogen deficit
  - anticoagulants
- Increased
  - Increased fibrinogen
  - better PLT function (±)



MA amplitude

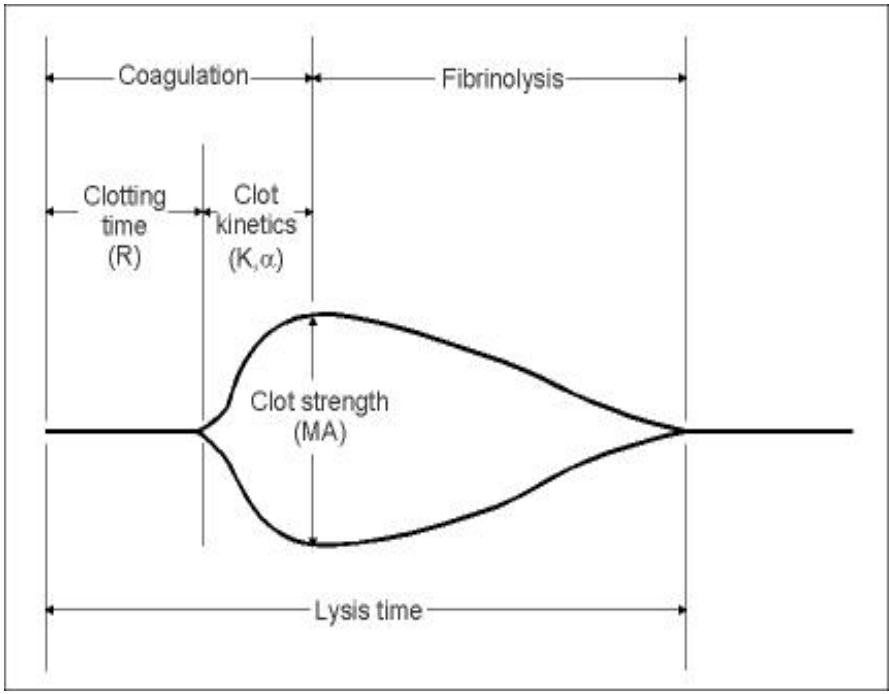
- 50 – 70 mm
- **Maximum Amplitude**
- strength of a clot
  - dependent on number and function of platelets and its interaction with fibrin (via GP . IIb/IIIa)
- **MA/ 60:**
- rate of amplitude reduction 60 min. after MA and represents the stability of the clot.

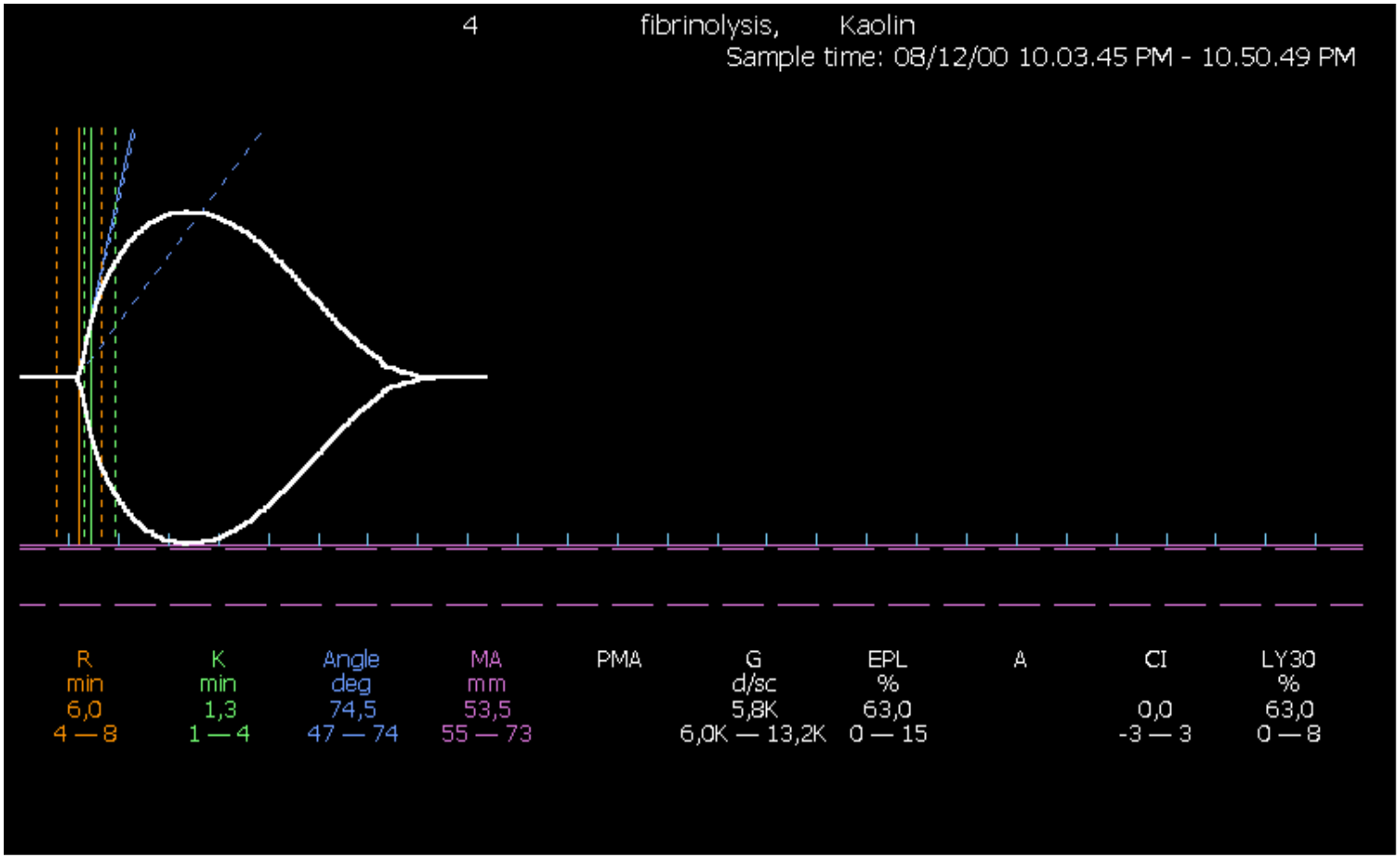
- Correlated with
  - **<u>PLT number and function</u>**
  - fibrin



clot lysis parameters

- Clot lysis index (A_{60}/MA *100)
  - Lysis index
    - > 85%
- Clot lysis time
  - (LY 30; LY 60)
  - Lysis index at 30 and 60 mins
    - TEG AUC




4 fibrinolysis, Kaolin
Sample time: 08/12/00 10.03.45 PM - 10.50.49 PM
R
min
6,0
4 — 8
K
min
1,3
1 — 4
Angle
deg
74,5
47 — 74
MA
mm
53,5
55 — 73
PMA
G
d/sc
5,8K
6,0K — 13,2K
EPL
%
63,0
0 — 15
A
CI
0,0
-3 — 3
LY30
%
63,0
0 — 8

TEG® Guided Hemostasis and Bloc

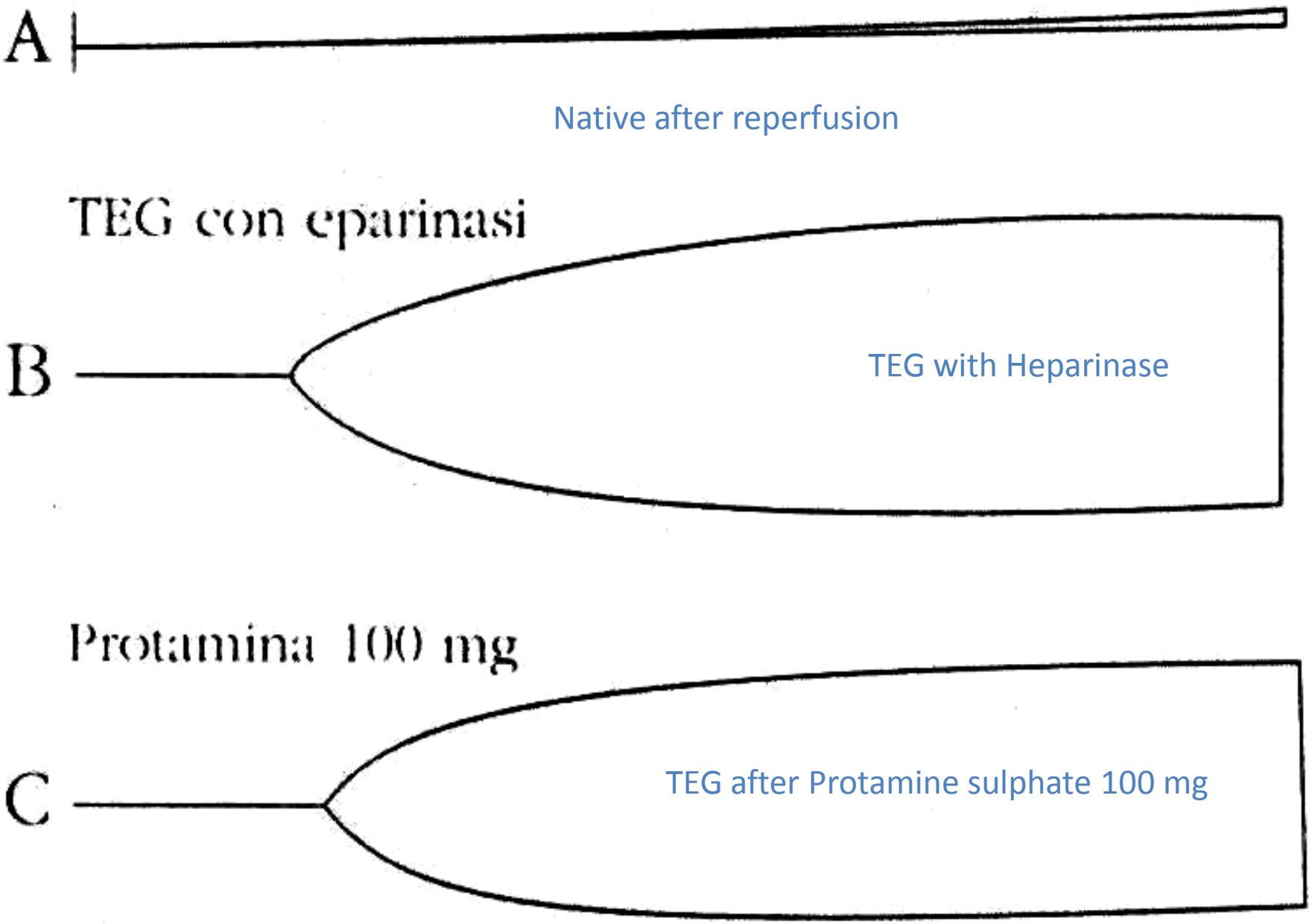
III. Treatment Guide

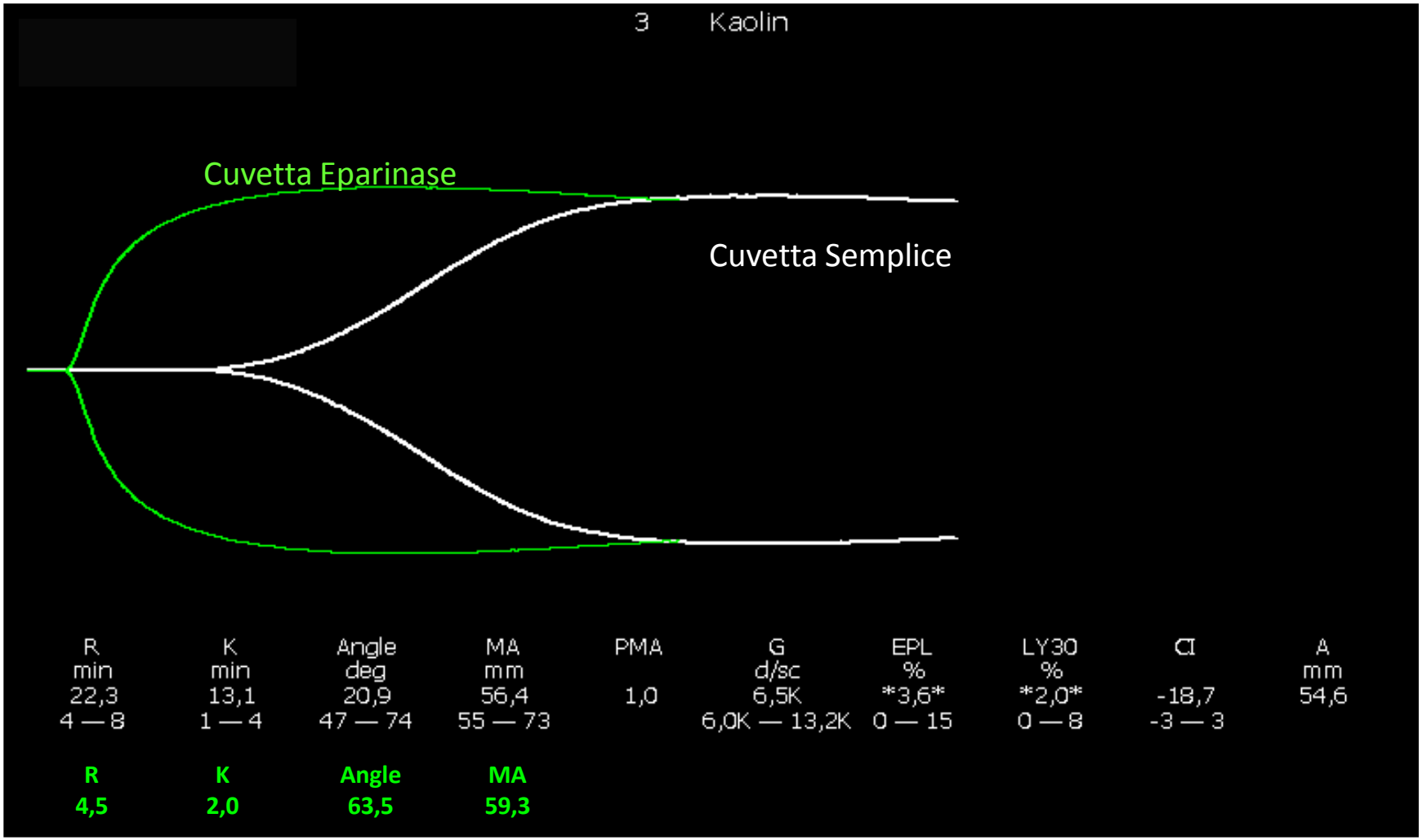
TEG® value	Hemostasis state	Common treatment
R between 11-14 min	↓ clotting factors	x 2 FFP or 8 ml/kg[7,8,26]
R greater than 14 min	↓↓ clotting factors	x 4 FFP or 16 ml/kg[1,5,26]
MA between 46 -54 mm	↓ platelet function	.3μg/kg DDAVP[27,11] ♠♠
MA between 41 -45 mm	↓↓ platelet function	x5 platelet units[8,26]
MA at 40 mm or less	↓↓↓ platelet function	x10 platelet units[5,26,8,1]
α less than 45°	↓ fibrinogen level	.06 u/kg cryo[5]
LY30 at 7.5% or greater, C.I. less than 1.0	Primary fibrinolysis	antifibrinolytic of choice[5,1]
LY30 at 7.5% or greater, C.I. greater than 3.0	Secondary fibrinolysis	anticoagulant of choice[5,1,15]
LY30 less than 7.5%, C.I. greater than 3.0	Prothrombotic state	anticoagulant of choice[11,15]
R less than 4 min or MA greater than 73	Prothrombotic state	anticoagulant of

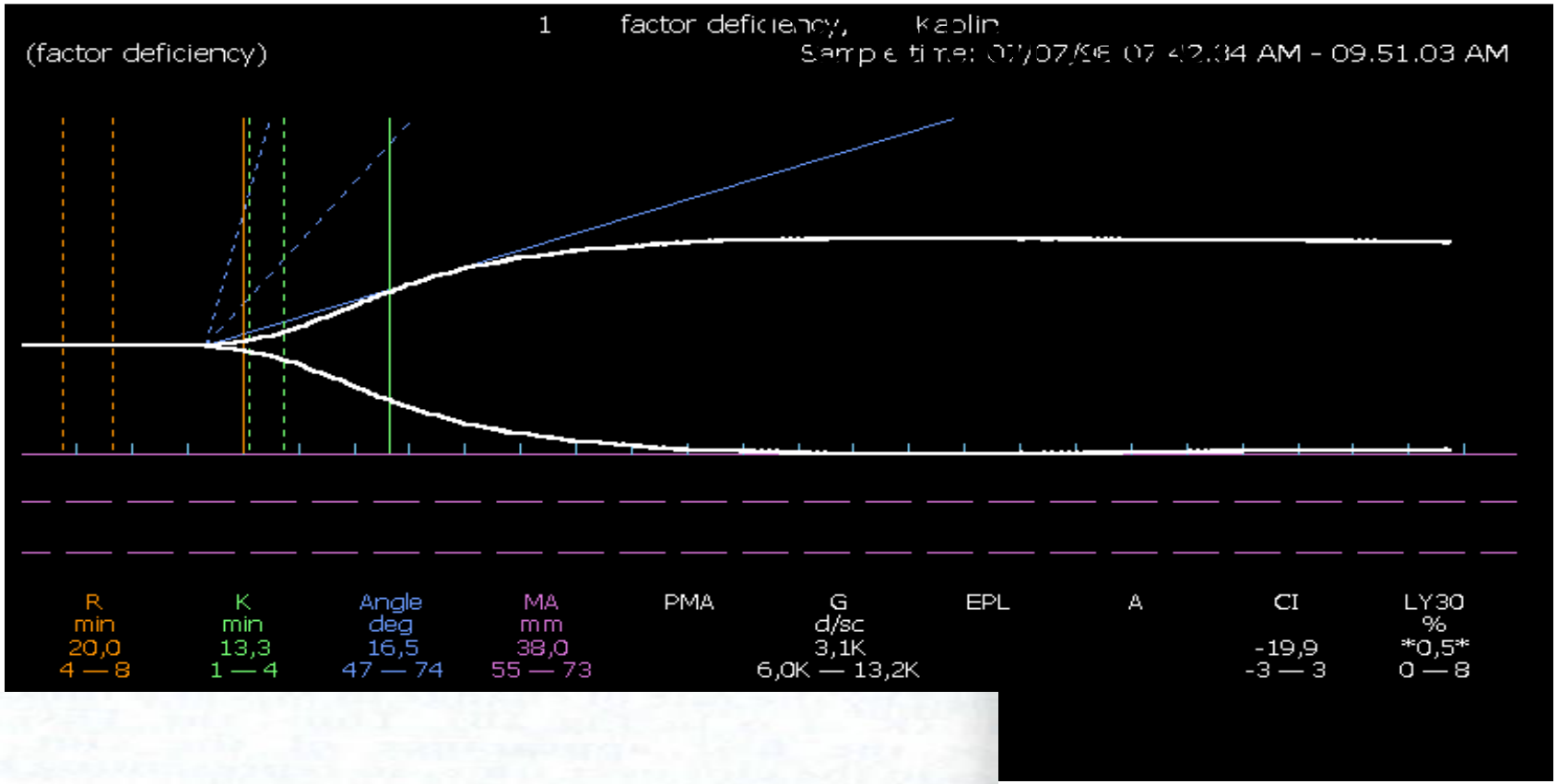
Table 3. Example of a TEG based transfusion protocol

TEG Parameter	Level	Action
r time	Increased	FFP
K time	Increased	Cryoprecipitate
Alpha Angle	Decreased	Cryoprecipitate
MA	Decreased	Platelets
Lysis index	Increased	Antifibrinolytics

Modified from Stahel et al,[20] Enriquez et al,[22] and Avidan et al.[23]


A
Native after reperfusion
TEG con eparinasi
B
TEG with Heparinase
Protamina 100 mg
C
TEG after Protamine sulphate 100 mg


3 Kaolin
Cuvetta Eparinase
Cuvetta Semplice
R min 22,3 4 — 8
K min 13,1 1 — 4
Angle deg 20,9 47 — 74
MA mm 56,4 55 — 73
PMA 1,0
G d/sc 6,5K 6,0K — 13,2K
EPL % *3,6* 0 — 15
LY30 % *2,0* 0 — 8
CI -18,7 -3 — 3
A mm 54,6
R 4,5
K 2,0
Angle 63,5
MA 59,3



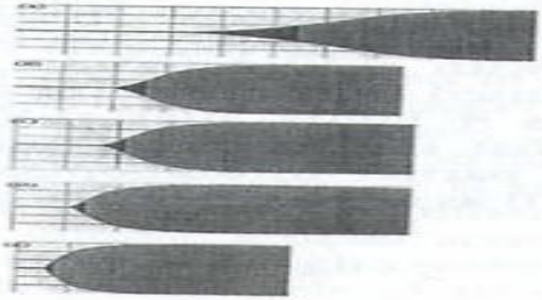
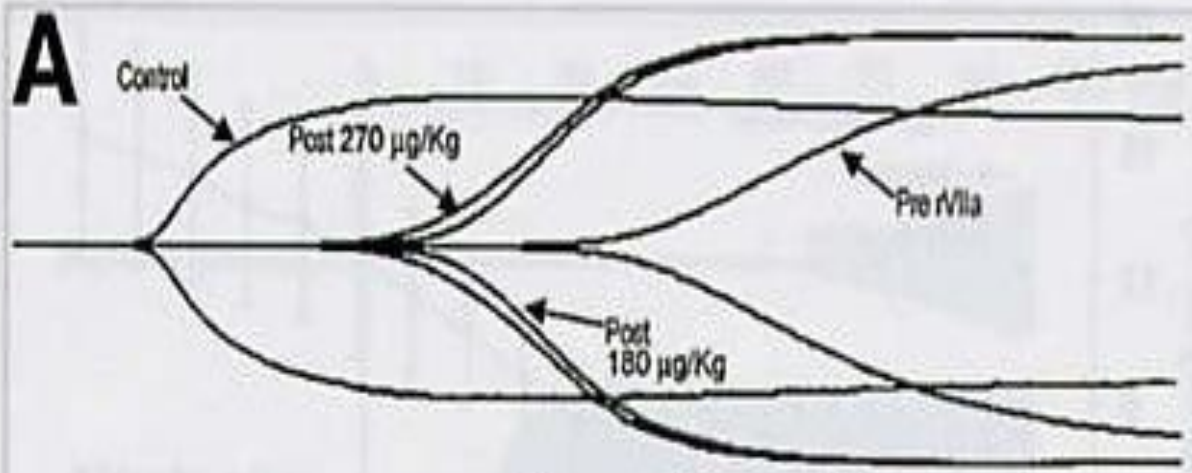


Figure 5. ROTEG output from an investigation of the e
increasing doses of rFVIIa on the clotting of whole bloo
patients with severe hemophilia. Reprinted from Ingersle
with permission of Lippincott Williams & Wilkins.



	R (sec)	K (sec)	MA (mm)	G (dynes/cm²)
Control	553	175	53.5	5752.7
Patient Pre rVIIa (Baseline)	2401	625	70.0	11666.7
Patient Post 180 µg/Kg rVIIa	1657	400	75.5	15408.2
Patient Post 270 µg/Kg rVIIa	1492	470	76.0	15833.3

But…..

- TEG has not gained universal acceptance, especially among hematologists.
- The sensibility and sensitivity of TEG in the identification of the coagulation abnormalities are not well defined.
- An abnormal trace is not always associated with abnormal bleeding and may resolve spontaneously without treatment.

Anesthesiology
2000; 92:1223–5

Thromboelastography®
Past, Present, and Future

chief limitations of the TEG® include its: (1) inability to diagnose a specific hemostatic lesion; (2) weak correlation with specific assays (prothrombin and activated partial thromboplastin times); and (3) inability to consistently detect benefits of fractionated blood product therapy.[4]

Anesthesiology
2000; 92:1223–5

Thromboelastography®
Past, Present, and Future

Many transfusion medicine specialists feel that near-site hemostasis monitoring could significantly improve clinical decision-making in patients undergoing surgery. Until recently, the vast majority of studies using the TEG® have been descriptive in design and, therefore, have had a limited impact on clinical decision-making. The next major advance will require a multicenter, interdisciplinary approach to design the studies needed to establish evidence-based transfusion algorithms. If multidisciplinary teams do not address these remaining issues, use of the TEG® in the perioperative period will remain limited.

Clin. Lab. Haem.
2005, **27**, 81–90 **REVIEW**

Thrombelastography/thromboelastometry

R. J. LUDDINGTON *Haematology Department, Addenbrooke's Hospital, Cambridge, UK*

Conclusion

The TEG®/ROTEM® has been used for many years as a guide to blood product and drug administration during cardiac and hepatic surgery. It is capable of providing a robust, inexpensive, snapshot of haemostasis at the bedside. For laboratory use, the need for an anticoagulated sample has led to stricter controls over sample handling. The search for a 'global' assay of haemostasis continues and the TEG®/ROTEM® or a derivative of this technology may provide the answer, or part of the answer, to that quest. There is more work to be carried out particularly with regard to standardization and reagent optimization before this potential can be fully evaluated.

Standardization of Thromboelastography: Values and Challenges

Meera Chitlur, M.D.,[1] and Jeanne Lusher, M.D.[1]

Semin Thromb Hemost 2010;36:707–711.

their reliability. The number of publications in the field of thromboelastography is growing daily, and many areas of clinical medicine are targeting the ability of this assay to evaluate in real time the process of coagulation and fibrin polymerization. It is clear that the methods employed by different investigators differ significantly, and therefore the results are not comparable. It is therefore critical to standardize the assay to achieve clinical relevance. This article summarizes the TEG-ROTEM Working Group's efforts to try and standardize thromboelastography and the challenges faced in this process. Although this has been the first effort to standardize this test, it is extremely important to continue this work, so that we may investigate the usefulness and possible applications of thromboelastography in evaluating the process of hemostasis.

Wien Klin Wochenschr (2010) 122 [Suppl 5]: S19–S20

Printed in Austria

Wiener klinische Wochenschrift
The Middle European Journal of Medicine

Point of care diagnostic: thromboelastometry (ROTEM®)

Thorsten Haas

Department of Anaesthesiology and Critical Care Medicine, Medical University of Innsbruck, Innsbruck, Austria

Nevertheless, one has to accept that even thromboelastometry is an artificial system that may not be able to analyse shear stress or endothelial influence. Additionally, ROTEM was not designed to detect disturbances in primary haemostasis; therefore alternative point-of-care tests such as the multiplate® or PFA-100® system need to be performed to answer these questions.

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Point of care diagnostic: thromboelastometry (ROTEM®)

Thorsten Haas

Department of Anaesthesiology and Critical Care Medicine, Medical University of Innsbruck, Innsbruck, Austria

In sum, the ROTEM device offers a fast diagnosis of haemostasis disorders by providing graphical and numeric information that enables the user to gain a more detailed insight into the complex interaction of the coagulation system. Future investigations are warranted to proof the assumption that a more targeted approach of coagulation therapy might lead to less use of blood products, shortening of time in critical care unit and finally a decrease in morbidity and mortality.

Perioperative bleeding: surgical or not surgical…

The management of perioperative bleeding

M. B. C Koh, Beverley J. Hunt

Blood Reviews (2003) 17, 179–185

- surgical bleeding
  - failure to control bleeding vessels at the operative side
    - surgical technical problem
    - surgical technical solution

- non surgical or “haemostatic bleeding”
  - failure of the haemostatic pathways
    - generalized oozing

European Journal of Anaesthesiology 2003; 20: 764–770

ISSN 0265-0215

Review

Strategies to reduce perioperative blood loss related to non-surgical bleeding

diffuse bleeding from numerous tiny capillaries. In the following, this type of blood loss will be referred to as 'non-surgical blood loss'. Since it cannot be treated mechanically by clipping or ligation, it is mostly the anaesthetist who is challenged by this type of bleeding. An imbalance between coagulation and fibrinolysis, and a lack or malfunction of platelets are possible reasons for such non-surgical bleeding.

Managing critical bleeding in the periop period : a team – based procedure

- better surgical techniques
  - aggressive surgical / invasive approach
  - innovative technologies
    - CUSA , Cavitron
  - fibrin glues

- better understanding of the physiologic profile performed by anesthesia / CCM physicians
  - appropriate resuscitative measures
  - ad hoc monitoring to understand the haemostatic derangements
  - appropriate correction of the hemostatic defects
    - blood components
    - drugs
  - treatment of the underlying cause(s)
    - if possible

…to correct the bleeding tendency….or disorders

- Diagnosis of the underlying defect (hopefully)
- in vitro testing of efficacy of correct of coagulation abnormalities with
  - blood components
  - pharmacological agents
    - DDAVP
    - Antifibrinolytic agents
      - » tranexamic acid
      - » Aprotinin
      - » Protamine sulphate
      - » rFVIIa
  - combination therapy

European Journal of Anaesthesiology 2003; **20**: 764–770

ISSN 0265-0215

Review

Strategies to reduce perioperative blood loss related to non-surgical bleeding

A. Menzebach*, U. Cassens†, H. Van Aken*, M. Booke‡

...to correct the bleeding tendency….or disorders

- Diagnosis of the underlying defect (hopefully)
- in vitro testing of efficacy of correction of coagulation abnormalities with
  - blood components
  - pharmacological agents
    - DDAVP
    - Antifibrinolytic agents
      - » tranexamic acid
      - » Aprotinin
      - » Protamine sulphate
      - » rFVIIa
  - combination therapy

Fibrinogen

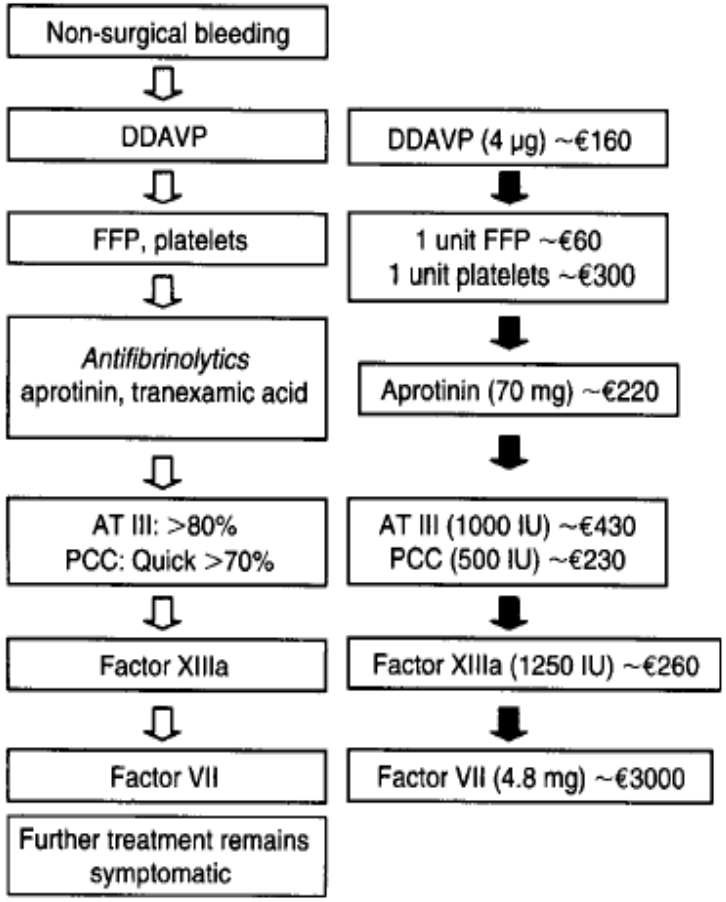

Figure 1.
Step-by-step approach to the treatment of non-surgical blood loss.