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PONTIFICIA UNIVERSIDAD  
CATÓLICA DE CHILE

# Tromboelastograma y su utilidad en clínica

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## Antecedentes relevantes y contexto

- EL sangrado peri operatorio es una causa importante de morbi-mortalidad asociada a cirugías complejas.
- Se estima que 1/3 del sangrado postoperatorio se debe al alteraciones de la hemostasia (no quirúrgica).
- Históricamente, las guías clínicas para el uso de hemocomponentes basan sus gatillos transfusionales en pruebas de coagulación convencionales como TP, INR, TTPA, recuento plaquetario y niveles de Fibrinógeno (éste último solo más recientemente).

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## Usefulness of standard plasma coagulation tests in the management of perioperative coagulopathic bleeding: is there any evidence?

T. Haas<sup>1\*</sup>, D. Fries<sup>2</sup>, K. A. Tanaka<sup>3</sup>, L. Asmis<sup>4</sup>, N. S. Curry<sup>5</sup> and H. Schöchl<sup>6,7</sup>

- The authors review the evidence for the continued use of standard laboratory tests of coagulation.
- They conclude that there is minimal evidence for the use of standard laboratory tests in guiding the management of perioperative bleeding.

### Conclusiones:

- Las PCE no fueron diseñadas para evaluar compromiso de la generación de trombina.
- Los valores usados como “anormales” (1,5 veces el valor normal) no se basan en evidencia si no en hábitos de larga data.
- Las PCE están ampliamente disponibles y son muy usadas, pero no existe evidencia que confirme que éstas son útiles para diagnóstico de coagulopatía ni para guiar una terapia hemostática.
- Los tiempos de ejecución son demasiado largos para escenarios intra operatorios ni de emergencia.
- Se realizan en plasma, sin elementos celulares.

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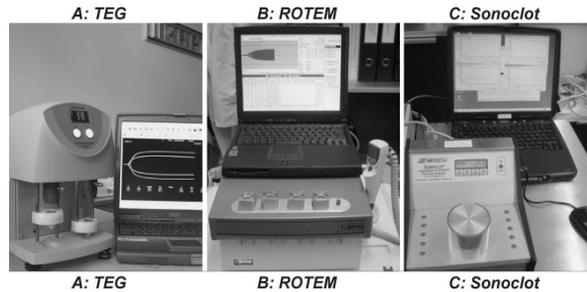
## Entonces ... ¿qué podemos usar?

[4] Hartert H. Blutgerinnungsstudien mit der thromboelastographie, einem neuen Untersuchungsverfahren. Klin Wochenschrift 1948;26:557-83.

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## Pruebas visco elásticas (PVE) de la hemostasia

**Figure 1.** Viscoelastic point-of-care coagulation devices. A, Thrombelastograph, TEG (Hemoscope Corp., Niles, IL). B, Rotation Thrombelastometry, ROTEM (Pentapharm GmbH, Munich, Germany). C, Sonoclot Analyzer (Sienco Inc., Arvada, CO).



Ganter M, Hofer C. Coagulation Monitoring: Current Techniques and Clinical use of Viscoelastic Point-of-Care Coagulation Devices. *Anesth Analg* 2008; 106: 1366 – 75.

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## Pruebas visco elásticas (PVE) de la hemostasia

- Se basan en el principio de que el resultado final del proceso hemostático es un **trombo** cuyas **propiedades físicas** determinan el **estado hemostático** (o competencia hemostática) del paciente.
- Las pruebas visco elásticas **grafican** estas propiedades físicas del trombo

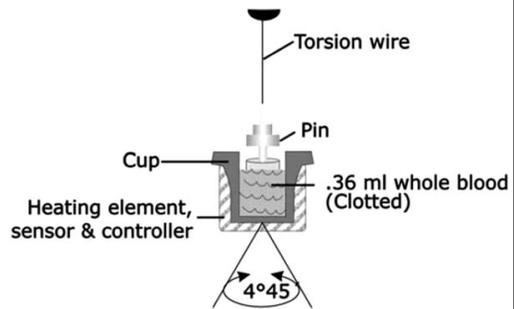


TRANSFUSION Volume 53, July 2013

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## Tromboelastograma (TEG)

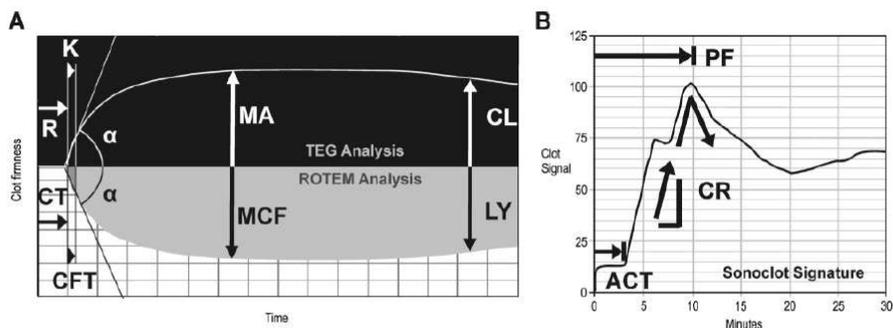
- El alambre de torsión está conectado a un transductor mecánico-eléctrico.
- En la medida que se forma el coágulo, los cambios en la rotación del *pin* se convierten en señales eléctricas que generan un *output* numérico y gráfico.



Am. J. Hematol. 89:228–232, 2014.

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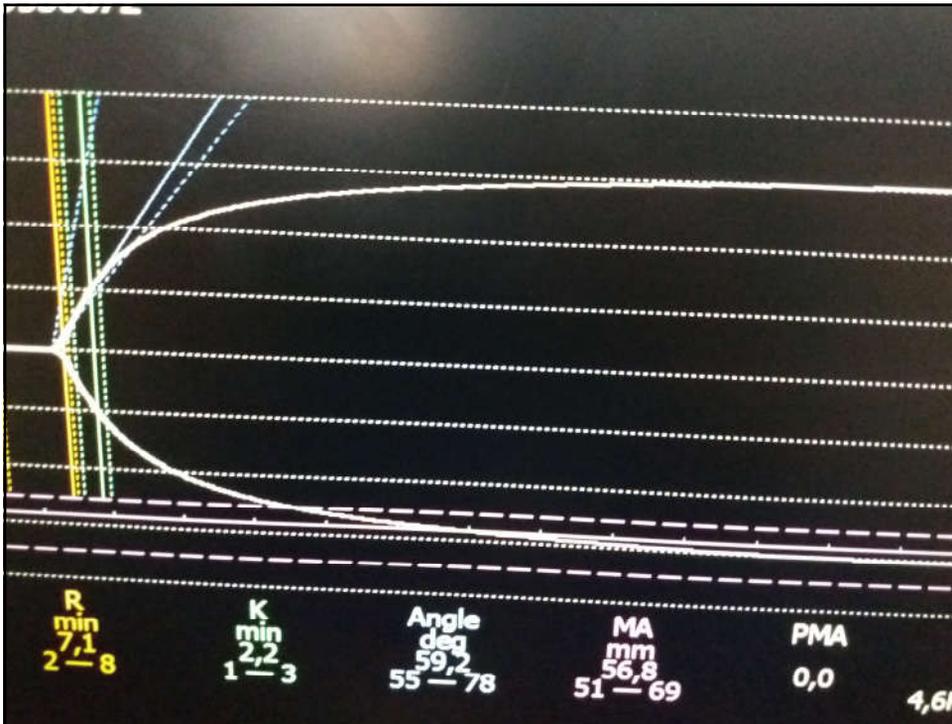
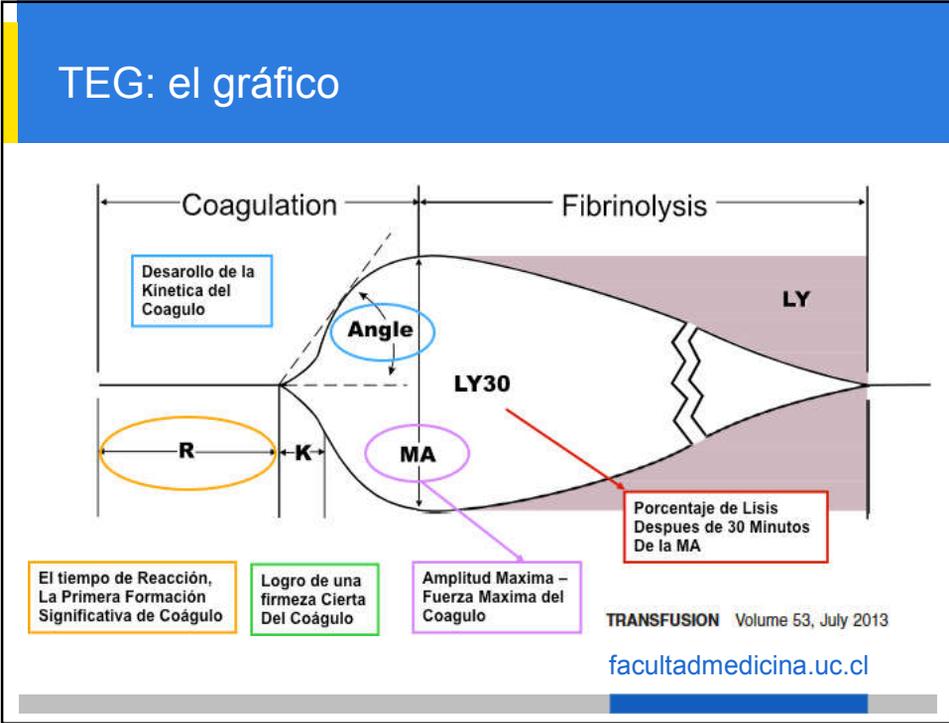
## PVE: representación gráfica

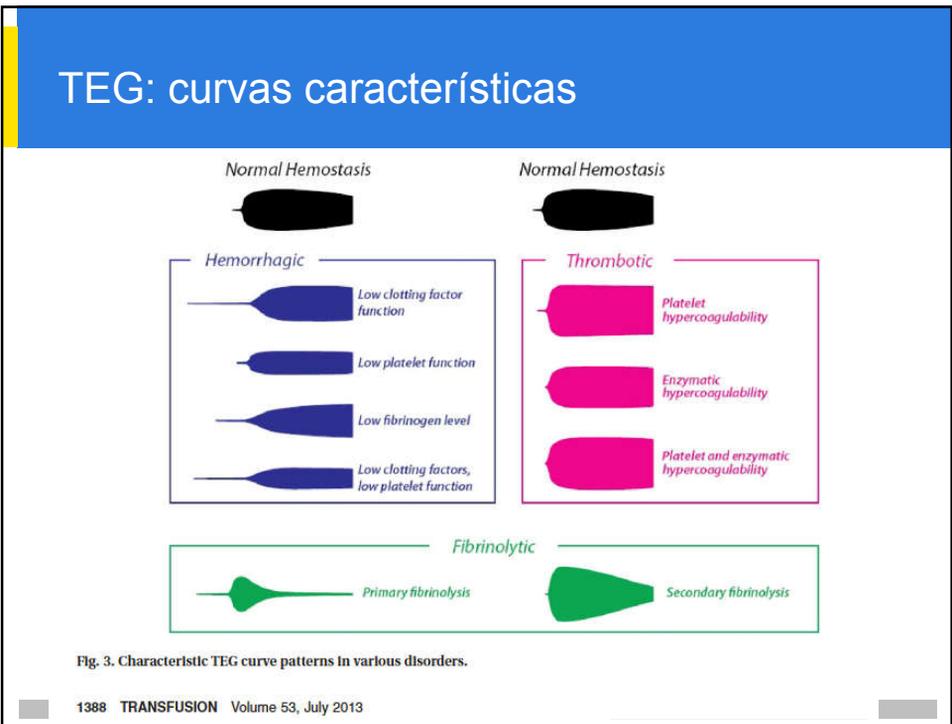
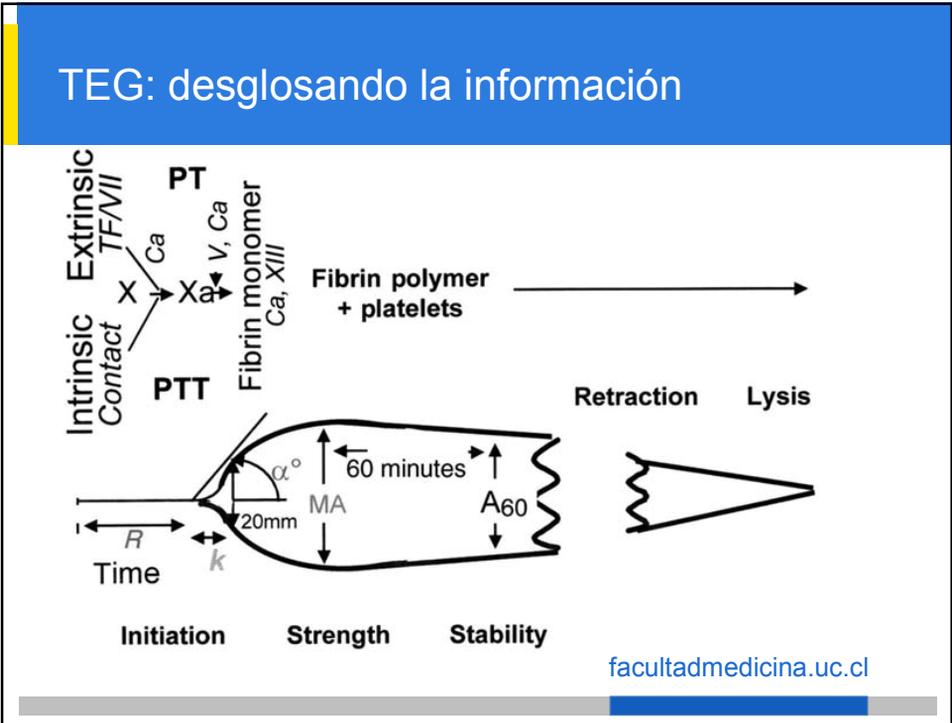


**Figure 3.** Typical tracings of viscoelastic point-of-care coagulation devices. A, upper side: Thrombelastograph (TEG®) tracing: *r* = reaction time; *K* = kinetics;  $\alpha$  = slope between *r* and *k*; *MA* = maximum amplitude; *CL* = clot lysis. A, lower side: Rotation Thrombelastography (ROTEM®) tracing: *CT* = clotting time; *CFT* = clot formation time;  $\alpha$  = slope of tangent at 2 mm amplitude; *MCF* = maximal clot firmness; *LY* = Lysis. B, Sonoclot Signature: *ACT* = activated clotting time; *CR* = clot rate; *PF* = platelet function. For detailed description and reference values, see Tables 2 and 3.

Ganter M, Hofer C. Coagulation Monitoring: Current Techniques and Clinical use of Viscoelastic Point-of-Care Coagulation Devices. *Anesth Analg* 2008; 106: 1366 – 75.

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# TEG: algoritmo de análisis

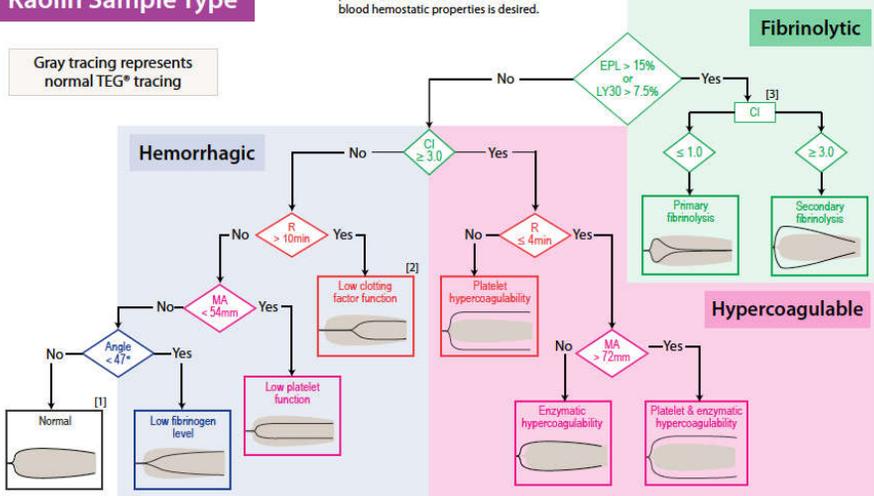
## TEG® Analysis Tree

### Kaolin Sample Type

The TEG is indicated for use with adult patients where an evaluation of their blood hemostatic properties is desired.

**HAEMONETICS®**  
THE Blood Management Company

Gray tracing represents normal TEG® tracing



1, 2, 3 See footnotes section on other side. References for TEG analysis tree can be found at [www.haemonetics.com](http://www.haemonetics.com)

US Patent 6,787,363

## TRANSFUSION MEDICINE REVIEW

Vol 26, No 1

January 2012

### Principles and Practice of Thromboelastography in Clinical Coagulation Management and Transfusion Practice

Daniel Bolliger, Manfred D. Seeberger, and Kenichi A. Tanaka

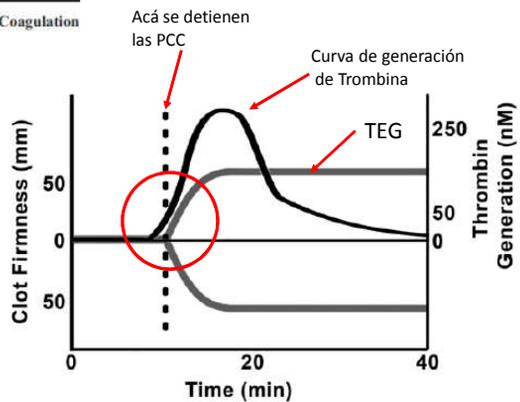


Fig 3. Typical traces of thromboelastography (the gray trace) and thrombin generation (the black trace). The dotted vertical line indicates where the conventional coagulation tests (PT/aPTT) stop in relation to thrombin generation and thromboelastography.

## Utilidad de las PVE: preguntas por responder

¿Hay cambios en el uso de hemocomponentes?

¿Tienen valor predictivo de hemorragia o trombosis?

¿Su uso impacta la morbimortalidad ?



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## Estudios y evidencia sobre uso de PVE

Existe evidencia de la utilidad (\*) del uso de pruebas visco elásticas en:

- Trauma
- Cirugía cardíaca y vascular
- Cirugía ortopédica
- Trasplante Hepático
- Hemorragia obstétrica



(\*) definida en cada estudio, en general sobre uso de hemocomponentes

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## #1: PVE en Trauma

- Cerca del 40% de las muertes por trauma se deben sangrado por coagulopatía.
- Basado en experiencias de trauma bélico, se establecieron protocolos de reanimación en trauma con administración de GR:PFC:PLQ en una relación de 1:1:1, disminuyendo la mortalidad de pacientes con sangrado masivo.

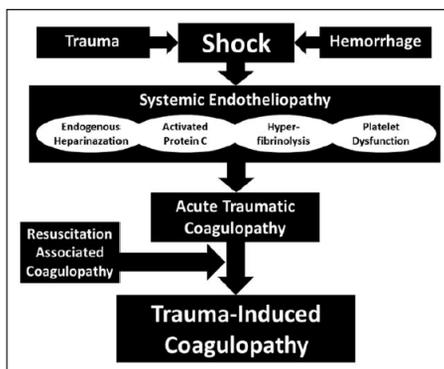


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## Early haemorrhage control and management of trauma-induced coagulopathy: the importance of goal-directed therapy

Jakob Stensballe<sup>a,b,c</sup>, Hanne H. Henriksen<sup>b</sup>, and Pär I. Johansson<sup>b,d,e</sup>



Curr Opin Crit Care 2017, 23:503–510

DOI:10.1097/MCC.0000000000000466

**FIGURE 1.** Flow chart on the current understanding of trauma-induced coagulopathy. The current understanding of factors associated with the development of trauma-induced coagulopathy. Shock is the driver for the systemic endotheliopathy resulting in endogenous anticoagulation entitled as Acute Traumatic Coagulopathy. Acute traumatic coagulopathy and resuscitation associated coagulopathy are the main causes of trauma-induced coagulopathy associated with increased mortality and morbidity.

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**Table 1.** Goal-directed thrombelastograph treatment algorithm for bleeding patients as used in the Copenhagen Concept, Denmark

TEG citrated kaolin	Coagulopathy	Treatment options
R >9 min	Coagulation factors ↓	Plasma 10–20 ml/kg
FF <sub>MA</sub> <18 mm	Fibrinogen ↓	Fibrinogen concentrate 30–50 mg/kg or Cryoprecipitate 5–10 ml/kg
MA <50 mm and FF <sub>MA</sub> >18 mm	Platelets ↓	Platelets 5 ml/kg
Ly30 >3%	Hyperfibrinolysis	TXA 1–2 g IV or 10–20 mg/kg

Thrombelastograph (TEG) performed in Citrated kaolin: R, reaction time (normal range 3–9 min), MA, maximum amplitude (normal range 51–69 mm); Ly30, hyperfibrinolysis after 30 min (normal range <3%). FF<sub>MA</sub>, functional fibrinogen MA (normal range 18–24 mm); TXA, tranexamic acid.

Curr Opin Crit Care 2017, 23:503–510

DOI:10.1097/MCC.0000000000000466

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Veigas et al. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* (2018) 24:114  
DOI: 10.1186/s13049-018-0308-2

Scandinavian Journal of Trauma,  
Resuscitation and Emergency Medicine

REVIEW

Open Access



## A systematic review on the rotational thrombelastometry (ROTEM®) values for the diagnosis of coagulopathy, prediction and guidance of blood transfusion and prediction of mortality in trauma patients

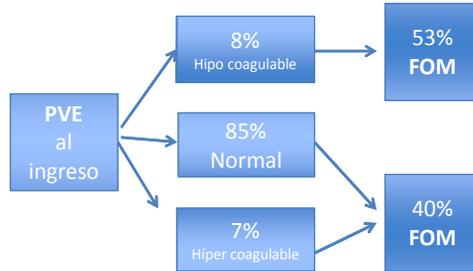
Precilla V. Veigas<sup>1</sup>, Jeannie Callum<sup>2</sup>, Sandro Rizoli<sup>3</sup>, Bartolomeu Nascimento<sup>4</sup> and Luis Teodoro da Luz<sup>5\*</sup>

- 13 estudios observacionales
- 2835 pacientes de trauma, adultos
- Los resultados de los estudios fueron agrupados en 3 categorías:
  - Diagnóstico de coagulopatía
  - Predicción de transfusión masiva o uso para guiar reanimación
  - Predicción de mortalidad
- La hiperfibrinolisis se asocia a mayor mortalidad

Los parámetros de ROTEM se asociaron consistentemente con el diagnóstico de coagulopatía, aumento del riesgo de sangrado y TM y predicción de MORTALIDAD

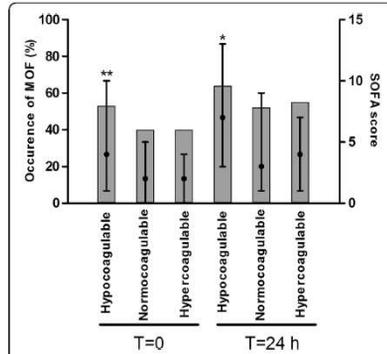
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## Thromboelastometry and organ failure in trauma patients: a prospective cohort study



**Key messages**

- Up to 10% of trauma patients show hypercoagulable ROTEM profiles within the first 24 hours after admission.
- Hypocoagulable, but not hypercoagulable profiles in trauma patients, are associated with adverse outcome.
- Further research on the prognostic value of ROTEM profiles in trauma patients is warranted and should focus on sequential measurements to further elucidate coagulation patterns and their influence on patient outcomes.



**Figure 2** Occurrence of multiple organ failure and the worst SOFA scores in patients with hypo-, normo- and hypercoagulable profiles at admission and 24 hours after admission. Gray bars indicate occurrence of multiple organ failure and black dots indicate median SOFA scores and interquartile ranges. \**P* < 0.01. \*\**P* < 0.05. MOF: multiple organ failure; SOFA: sequential organ failure assessment.

## TEG®- or ROTEM®-based individualized goal-directed coagulation algorithms: don't wait - act now!

Donat R Spahn

**Abstract**

In trauma patients, TEG® and ROTEM® allow prediction of massive transfusion requirement and mortality, and creation of goal-directed, individualized coagulation algorithms that may improve patient outcome. This outcome benefit has been shown for cardiac surgery in prospective randomized trials. For trauma, only non-randomized studies have been performed. Nevertheless, TEG® and ROTEM® are highly promising monitoring techniques to guide coagulation management in all types of major bleeding, including trauma.

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## #2: PVE en cirugía cardíaca

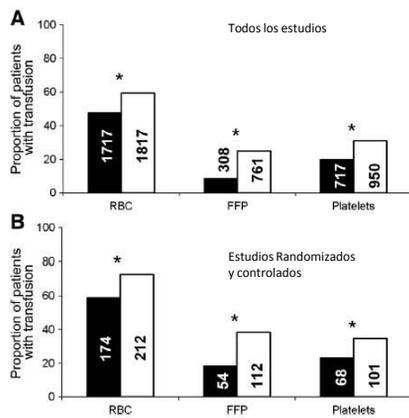


Fig. Frequency of transfusion of allogeneic blood products. Percentage of patients with transfusion of RBC concentrates, FFP, and platelets is shown. Black and white columns indicate the intervention (TEG or ROTEM guidance) and control groups, respectively. Numbers within the columns indicate patients with transfusion. A, All studies (3616 patients in the intervention group and 3067 in the control group). B, RCTs only (295 patients in the intervention group and 292 patients in the control group). \* $P < .05$ .



Contents lists available at ScienceDirect

Transfusion Medicine Reviews

journal homepage: [www.tmrreviews.com](http://www.tmrreviews.com)

Roles of Thrombelastography and Thromboelastometry for Patient Blood Management in Cardiac Surgery<sup>1,2</sup>

Daniel Bolliger<sup>1,2</sup>, Kenichi A. Tanaka<sup>2</sup>

<sup>1</sup> Department of Anaesthesia and Intensive Care Medicine, University Hospital, Basel, Switzerland

<sup>2</sup> Department of Anesthesiology/Transfusion Medicine Institute, University of Pittsburgh Medical Center, Pittsburgh, PA

Transfusion Medicine Reviews 27 (2013) 213–220

A: todos los estudios

B: los estudios controlados y randomizados

Columnas negras: intervención (PVE)  
Columnas blancas: control, pruebas de  
coagulación estándar y/o juicio clínico

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British Journal of Anaesthesia 114 (1): 91–102 (2015)  
Advance Access publication 10 October 2014 · doi:10.1093/bja/aeu339

BJA

### PAEDIATRICS

## Thromboelastometry-guided intraoperative haemostatic management reduces bleeding and red cell transfusion after paediatric cardiac surgery

Y. Nakayama<sup>1</sup>, Y. Nakajima<sup>1\*</sup>, K. A. Tanaka<sup>2</sup>, D. I. Sessler<sup>3</sup>, S. Maeda<sup>1</sup>, J. Iida<sup>1</sup>, S. Ogawa<sup>1</sup> and T. Mizobe<sup>1</sup>

- A thromboelastometry-based algorithm was developed and compared with conventional transfusion management in a single-centre study.

- An algorithm incorporating thromboelastometry led to reduced postoperative bleeding and shorter intensive care unit stay in paediatric cardiac surgical patients.

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### #3: PVE en cirugía ortopédica



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## Rotational thromboelastometry-guided blood product management in major spine surgery

Bhiken I. Naik, MBBCh,<sup>1,2</sup> Thomas N. Pajewski, MD, PhD,<sup>1,2</sup> David L. Bogdonoff, MD,<sup>1</sup> Zhiyi Zuo, MD, PhD,<sup>1,2</sup> Pamela Clark, MD, JD,<sup>3</sup> Abdullah S. Terkawi, MD,<sup>1</sup> Marcel E. Durieux, MD, PhD,<sup>1,2</sup> Christopher I. Shaffrey, MD,<sup>2</sup> and Edward C. Nemergut, MD<sup>1,2</sup>

TABLE 4. Predicted cost savings with ROTEM-guided therapy

J Neurosurg Spine 23:239-249, 2015

Blood Product	Predicted Cost if		Difference
	Actual Cost in Conventional Group	ROTEM Were Used in Conventional Group	
<b>TXA-treated patients</b>			
pRBC	\$25,650	\$20,025	-\$5625
FFP	\$2175	\$400	-\$775
Cryoprecipitate	\$558	\$1674	+\$1116
Platelets	\$4815	\$2675	-\$2140
Total cost	\$33,198	\$25,774	-\$7424
<b>Non-TXA-treated patients</b>			
pRBC	\$10,330	\$9900	-\$430
FFP	\$1344	\$896	-\$448
Cryoprecipitate	\$0	\$682	+\$682
Platelets	\$2675	\$980	-\$1695
Total cost	\$14,309	\$12,458	-\$1851

### Conclusions

We have demonstrated that the application of a goal-directed hemostatic approach with functional coagulation testing increases cryoprecipitate but reduces FFP use. This is due to hypofibrinogenemia as a major contributor to the ongoing coagulopathy. Early identification and management of hypofibrinogenemia is critical in major spine surgery as demonstrated by a reduction in blood loss cost-effective method to allogeneic blood product management in major spine surgery. Furthermore, by applying a ROTEM-guided algorithm, variance of transfusion practice can be reduced with increased standardization of care among different providers.

Nota: TXA usado en pacientes en quienes se espera mayor sangrado intra operatorio.

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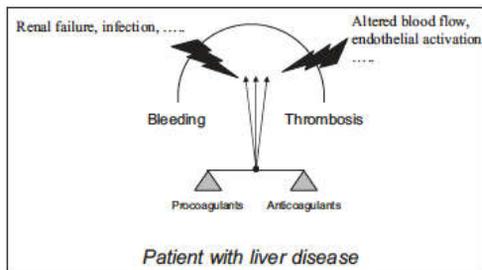
## #4: PVE en trasplante hepático



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## Hemostasia en DHC

LISMAN and PORTE  
REBALANCED HEMOSTASIS IN LIVER DISEASE  
BLOOD, 12 AUGUST 2010 • VOLUME 116, NUMBER 6



- PT y TTPA no tienen valor predictivo de sangrado
- La causa del DHC determina diferentes perfiles hemostáticos
- La trombosis intra hepática puede determinar la progresión de la enfermedad ...

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## The Coagulation Profile of End-Stage Liver Disease and Considerations for Intraoperative Management

Katherine T. Forkin, MD,\* Douglas A. Colquhoun, MBChB, MSc, MPH,†

Edward C. Nemergut, MD,\*‡ and Julie L. Huffmyer, MD\*

(Anesth Analg 2017;XXX:00-00)

### ↑ BLEEDING

#### Platelets

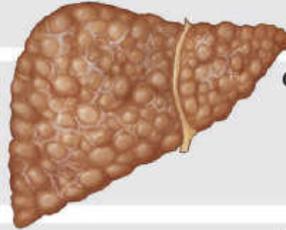
- ↓ Platelet count
- ↓ Platelet activation
- ↑ Nitric oxide
- ↑ Prostacyclin

#### Coagulation Factors

- ↓ Factors II, V, VII, X, XI
- ↓ Fibrinogen

#### Fibrinolysis

- ↑ Fibrinolysis
- ↓ TAFI
- ↑ t-PA



### ↑ CLOTTING

#### Platelets

- ↑ vWF, ULvWF
- ↓ ADAMTS13

#### Coagulation Factors

- ↓ Activated proteins C & S
- ↓ Antithrombin
- ↑ Factor VIII

#### Fibrinolysis

- ↓ Plasminogen
- ↑ PAI

**Table 2. Studies Evaluating Effect of Using of Viscoelastic Coagulation Tests on Perioperative Blood Product Transfusions**

Researchers	Sample Size	Patient Characteristics	Coagulation Test Used	Main Outcome
Wang et al (2010) <sup>64</sup>	28	Consecutive liver transplants (Jan 2005–Dec 2006); average MELD 11.6 in control group and 11.0 in TEG group.	Randomized to protocols guided by TEG versus standard measures (plt count, PT, aPTT, fibrinogen).	TEG-guided transfusion protocol resulted in reduced FFP transfusions (12.8 vs 21.5 units), but no difference in 3-year survival.
Alamo et al (2013) <sup>65</sup>	303	Consecutive liver transplants; average MELD not reported.	Case-control; retrospectively compared cases with and without intraoperative ROTEM use.	Use of ROTEM intraoperatively decreased pRBC, FFP and platelet transfusions in high risk patients (eg, MELD $\geq$ 21, retransplantation) and decreased postoperative complications.
De Pietri et al (2016) <sup>66</sup>	386	Consecutive liver transplants (Dec 2005–Dec 2014); average MELD 19.0 (prior to 2012) and 21.2 (2012–2014).	Cohort study; retrospectively compared a TEG-guided protocol with a newer TEG-guided protocol that included a FF-TEG test and fibrinogen concentrate administration.	Inclusion of FF-TEG test and fibrinogen concentrate use to a TEG-guided protocol decreased transfusion requirements of pRBCs, FFP and platelets, but no difference in 30-day or 6-month survival; fibrinogen concentrate use increased.
Roulet et al (2015) <sup>67</sup>	60	Consecutive liver transplants (Jun 2012–Jun 2013); average MELD 17 (without group) and 20 (with group).	Prospective study; compared 30 patients first without use of a ROTEM-based algorithm, then 30 patients with the use of a ROTEM-based algorithm.	No difference in blood product transfusions; small, nonsignificant increase in fibrinogen concentrate use.
Fayed et al (2015) <sup>68</sup>	100	Living-donor liver transplants (Apr 2011–Sept 2012); average MELD 16.3.	Prospective study; preoperative ROTEM values compared with intraoperative blood transfusion requirements using univariate and multivariate linear regression analysis.	Many preoperative ROTEM values were predictive of transfusion requirements, most significantly for FFP.

Abbreviations: aPTT, activated partial thromboplastin time; FFP, fresh frozen plasma; FF-TEG, fibrinogen functional thromboelastography; MELD, model of end-stage liver disease; pRBC, packed red blood cell; PT, prothrombin time.

(Anesth Analg 2017;XXX:00-00)

Contents lists available at [ScienceDirect](http://ScienceDirect)

**Digestive and Liver Disease**

journal homepage: [www.elsevier.com/locate/dld](http://www.elsevier.com/locate/dld)

Liver, Pancreas and Biliary Tract

**Thromboelastometry hypercoagulable profiles and portal vein thrombosis in cirrhotic patients with hepatocellular carcinoma**

Alberto Zanetto<sup>a,1</sup>, Marco Senzolo<sup>a,\*,1</sup>, Alessandro Vitale<sup>b</sup>, Umberto Cillo<sup>b</sup>, Claudia Radu<sup>c</sup>, Francesca Sartorello<sup>c</sup>, Luca Spiezia<sup>c</sup>, Elena Campello<sup>c</sup>, Kryssia Rodriguez-Castro<sup>a</sup>, Alberto Ferrarese<sup>a</sup>, Fabio Farinati<sup>d</sup>, Patrizia Burra<sup>a</sup>, Paolo Simioni<sup>c</sup>

<sup>a</sup> Multivisceral Transplant Unit, Department of Surgery, Oncology and Gastroenterology, Padua University Hospital, Italy  
<sup>b</sup> Hepatobiliary Surgery and Liver Transplantation Unit, Department of Surgery, Oncology and Gastroenterology, Padua University Hospital, Italy  
<sup>c</sup> Thrombosis and Haemorrhagic Diseases Unit, Thrombophilia and Haemophilia Center, Department of Medicine, Padua University Hospital, Italy  
<sup>d</sup> Gastroenterology, Department of Surgery, Oncology and Gastroenterology, Padua University Hospital, Italy

**Conclusions:** Hypercoagulability in HCC which can be detected by thromboelastometry is associated with increased risk of PVT even in Child A patients. The clinical implication of these findings deserves further investigation.

[Digestive and Liver Disease 49 \(2017\) 440–445](#)

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LIVER TRANSPLANTATION 19:852–861, 2013

ORIGINAL ARTICLE

**Intraoperative Hypercoagulability During Liver Transplantation as Demonstrated by Thromboelastography**

DominiK Krzanicki, Anita Sugavanam, and Susan Mallett  
 Department of Anaesthesia, Royal Free Hospital, London, United Kingdom

We suggest, however, that because hypercoagulability is not detected by conventional testing and can be present when these tests indicate hypocoagulation, viscoelastic testing should be used routinely for coagulation monitoring during liver transplantation. In addition to identifying coagulopathy early and allowing specific hemostatic therapy to be instituted, TEG may be crucially valuable in preventing unnecessary and potentially harmful transfusions of blood products into patients who are hypercoagulable on viscoelastic tests and at increased risk of developing thromboembolic complications.

Stage	Short R time (native)	Short R time (heparinase)	High G value (native)	High G value (heparinase)
Baseline	11	7	16	21
Dissection	23	18	19	20
Anhepatic	30	29	8	9
Reperfusion	4	18	6	10

Figure 2. Graph showing the change in the frequency of prothrombotic native and native-heparinase TEG characteristics by the stage of transplantation.

## #5: Hemorragia obstétrica

### Medical Advances in the Treatment of Postpartum Hemorrhage

Anne-Sophie Ducloy-Bouthors, MD,\* Sophie Susen, MD, PhD,†‡ Cynthia A. Wong, MD,§ Alex Butwick, MBBS, FRCA, MS,|| Benoit Vallet, MD, PhD,\* and Evelyn Lockhart, MD¶

Postpartum hemorrhage (PPH) is a leading cause of maternal mortality worldwide. Recent advances in the management of severe bleeding for trauma patients may provide insight into PPH management, but must be applied with caution considering the significant differences between trauma and obstetric patients. In this review, we summarized evidence for current management strategies for patients with major obstetric hemorrhage, including (1) rapid laboratory assessment of coagulopathy, (2) early transfusion of plasma and high plasma-to-red blood cell transfusion ratios in massive PPH, and (3) use of tranexamic acid and fibrinogen concentrates in the setting of PPH complicated by coagulopathy. (Anesth Analg 2014;119:1140–7)

Fibrinógeno

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#### Society for Obstetric Anesthesia and Perinatology

Section Editor: Cynthia A. Wong

### Prospective Longitudinal Study of Thromboelastography and Standard Hemostatic Laboratory Tests in Healthy Women During Normal Pregnancy

Ove Karlsson, MD,\* Tommy Sporrang, MD, PhD,† Andreas Hillarp, PhD,‡ Anders Jeppsson, MD, PhD,||¶ and Margareta Hellgren, MD, PhD†#

**CONCLUSIONS:** TEG® demonstrates increased coagulability and decreased fibrinolysis during pregnancy. There was a faster initiation of hemostasis, with a minor increase in clot strength. Fibrinolysis decreased during late pregnancy. Alternative cutoff limits for TEG® variables may be required during pregnancy. Standard hemostatic laboratory tests were as expected during pregnancy. Future studies are needed to ascertain whether viscoelastic methods are preferable to standard hemostatic tests for the diagnosis of coagulopathy during obstetric hemorrhage. (Anesth Analg 2012;115:890–8)

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Cochrane Database of Systematic Reviews

Cochrane Database of Systematic Reviews 2016, Issue 8. Art. No.: CD007871.  
DOI: 10.1002/14651858.CD007871.pub3.

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

Wikkelsø A, Wetterslev J, Møller AM, Afshari A

### Key results

In terms of efficacy, the use of TEG or ROTEM tests seem to reduce the need for all types of blood transfusions. However, we could not find fewer participants in need of further operations due to continuous bleeding, or at risk of massive bleeding with transfusion. Despite signs of benefit in regards to survival, our findings are hampered by the overall low quality of included studies. Assessment of harms indicated a reduced risk of kidney failure, while no other significant adverse events were found. However, the reported adverse event rates were very low. All included trials except two were marred by high risk of bias.

Fahrendorff et al. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* (2017) 25:39  
DOI 10.1186/s13049-017-0378-9

Scandinavian Journal of Trauma,  
Resuscitation and Emergency Medicine

REVIEW

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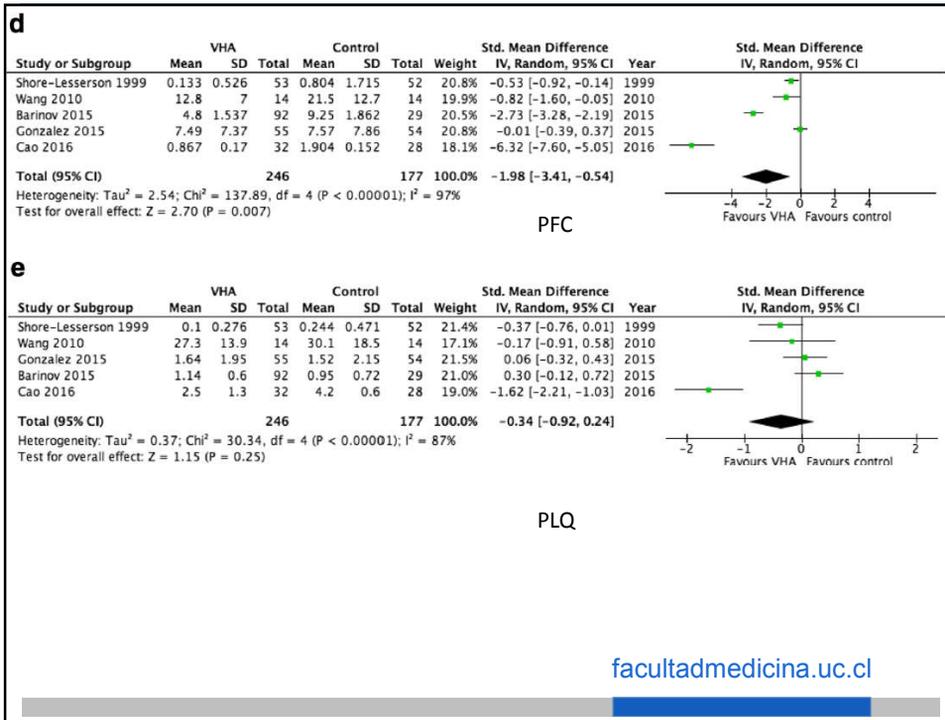
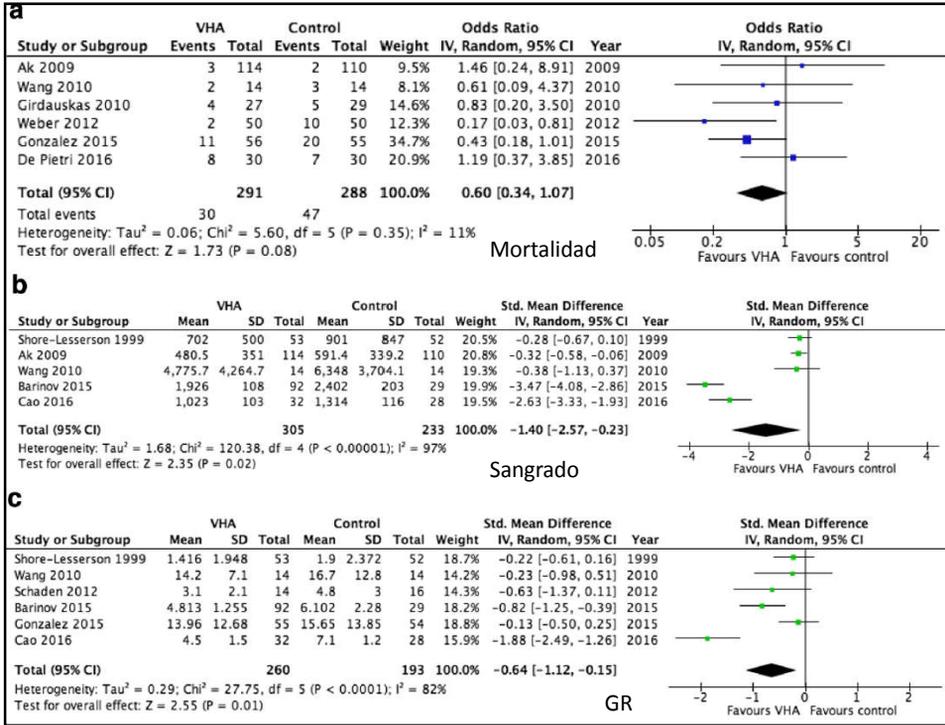


## The use of viscoelastic haemostatic assays in goal-directing treatment with allogeneic blood products – A systematic review and meta-analysis

Mathilde Fahrendorff<sup>1\*</sup>, Roberto S. Oliveri<sup>1</sup> and Pär I. Johansson<sup>1,2,3</sup>

**Results:** Fifteen RCTs ( $n = 1238$  patients) were included. Nine trials referred to cardiothoracic patients, one to liver transplantation, one to surgical excision of burn wounds and one to trauma. One trial was conducted with cirrhotic patients, one with patients undergoing scoliosis surgery while one trial randomised treatment in post-partum females presenting with bleeding. The amount of transfused red blood cells (RBCs), fresh frozen plasma (FFP) and bleeding volume was found to be significantly reduced in the VHA-guided groups, whereas no significant difference was found for platelet transfusion requirements or mortality.

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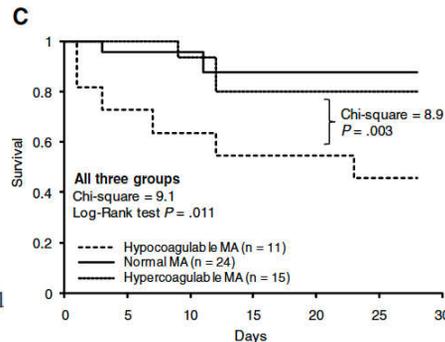


## Otras áreas de investigación y uso de PVE

### Consecutive thrombelastography clot strength profiles in patients with severe sepsis and their association with 28-day mortality: A prospective study<sup>☆</sup>

Sisse R. Ostrowski MD, PhD, DMSc<sup>a,\*</sup>, Nis A. Windeløv MD<sup>b</sup>, Michael Ibsen MD, PhD<sup>c</sup>, Nicolai Haase MD<sup>c</sup>, Anders Perner MD, PhD<sup>c</sup>, Pär I. Johansson MD, DMSc, MPA<sup>a,d</sup>

- En la mayoría de los pacientes, el perfil de TEG de ingreso se mantiene constante durante varios días.
- TEG hipocoagulable se asoció a mayor mortalidad precoz (80%) y a los 28 días.
- Al igual que en trauma, proponen que se debe a mayor daño endotelial.



Journal of Critical Care (2013) 28, 317.e1–317.e11

Journal of Critical Care 44 (2018) 7–11



Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: [www.jccjournal.org](http://www.jccjournal.org)



### The effect of sepsis and septic shock on the viscoelastic properties of clot quality and mass using rotational thromboelastometry: A prospective observational study



Gareth R. Davies<sup>a,b</sup>, Matthew Lawrence<sup>a,b</sup>, Suresh Pillai<sup>c</sup>, Gavin M. Mills<sup>c</sup>, Robert Aubrey<sup>c</sup>, Dafydd Thomas<sup>d</sup>, Rhodri Williams<sup>e</sup>, Keith Morris<sup>f</sup>, Phillip Adrian Evans<sup>a,b,c,\*</sup>

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- 50 pacientes con sepsis
- 20 pacientes con sepsis severa
- 30 pacientes en shock séptico
- En etapas precoces, hipercoagulabilidad
- En shock séptico prolongación del tiempo de coagulación pero con amplitud normal, pero menos fuerza y con alteración de la fibrinolisis

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## Thromboelastography Maximum Amplitude Predicts Postoperative Thrombotic Complications Including Myocardial Infarction

Douglas J. McCrath, MD, Elisabetta Cerboni, Robert J. Frumento, MS, MPH,  
Andrew L. Hirsh, BS, and Elliott Bennett-Guerrero, MD

Department of Anesthesiology, Columbia University College of Physicians & Surgeons, New York, New York

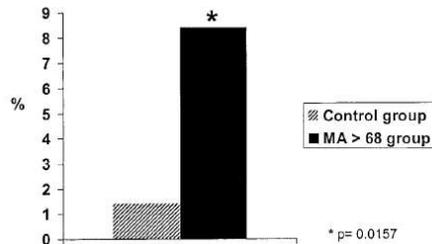


Figure 1. Patients with a confirmed thrombotic complication (deep vein thrombosis, pulmonary embolism, myocardial infarction, cerebrovascular accident) by presence or absence of increased maximum amplitude. Crosshatched bar = control group; solid bar = MA >68 group. \*P = 0.0157.

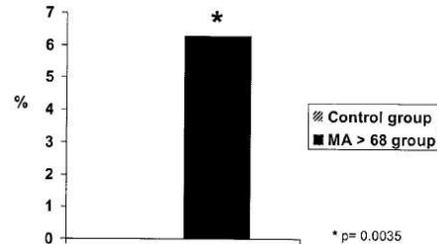


Figure 2. Patients with a confirmed myocardial infarction by presence or absence of increased maximum amplitude. Crosshatched bar = control group; solid bar = MA >68 group. \*P = 0.0035.

Anesth Analg 2005;100:1576-83

### En que estamos .... (afinando la interpretación)

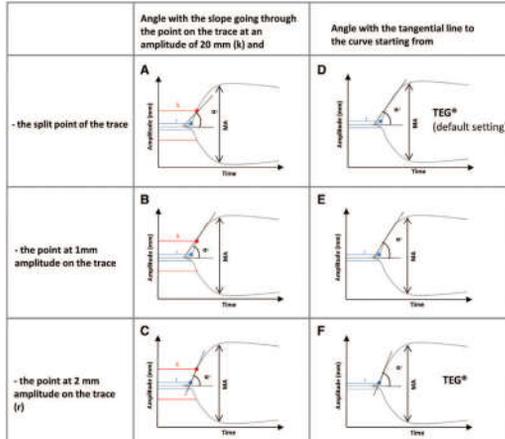
- Los algoritmos basados en TEG mono-análisis consideran los parámetros individuales del TEG como reflejo aislado de diferentes componentes de la hemostasia.
- No reconocen que las mediciones visco elásticas de la sangre total representan las interacciones entre procesos paralelos como son:
  - Generación de trombina
  - *Cross-linking* de fibrina
  - Agregación plaquetaria
- La suposición de que la suplementación de fibrinógeno depende del ángulo alfa y la de plaquetas de la amplitud máxima puede no ser correcta y requiere de mayor análisis.

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## Can the Viscoelastic Parameter $\alpha$ -Angle Distinguish Fibrinogen from Platelet Deficiency and Guide Fibrinogen Supplementation?

Cristina Solomon, MD, MBA,\*†‡ Herbert Schöch, MD,§¶ Marco Ranucci, MD,§ and Christoph J. Schlump, MD,‡||

Anesth Analg 2015; 121: 289 – 302.



**Figure 2.** Varying definitions of the  $\alpha$ -angle parameter. The  $\alpha$ -angle is calculated by the TEG® device as the angle formed by the tangential line to the curve starting from the split point of the trace (default setting, D) or starting from r (F). However, from the descriptions published in the literature, the following definitions are inferred: angle formed by the tangential line to the curve starting from 1 mm amplitude (E), angle formed by the slope going through k and the split point of the curve (A), the point at 1 mm amplitude (B), or r (C).

## En resumen

Ventajas del uso de PVE:

- Información precoz: resultados iniciales en minutos y en tiempo real.
- Información dinámica sobre la velocidad del inicio de la formación del trombo, la cinética de su desarrollo, fuerza y lisis.
- TEG mono-análisis tiene valor predictivo.
- Permiten guiar la elección apropiada de hemocomponentes.

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## Limitaciones de las PVE

- Expectativas: actualmente no hay estudios que demuestren que el uso de PVE (TEG o ROTEM) disminuyan **la morbimortalidad** asociada a patologías que requieren transfusión masiva.
- Esto es esperable, ya que **ningún examen de laboratorio tiene potencial terapéutico**.
- El impacto de su uso depende de la **interpretación**.
- Es muy probable que el TEG mono-análisis deba ser complementado con mediciones adicionales para una correcta individualización de los componentes de la hemostasia y su impacto en situaciones clínicas particulares.

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¡Muchas gracias!

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