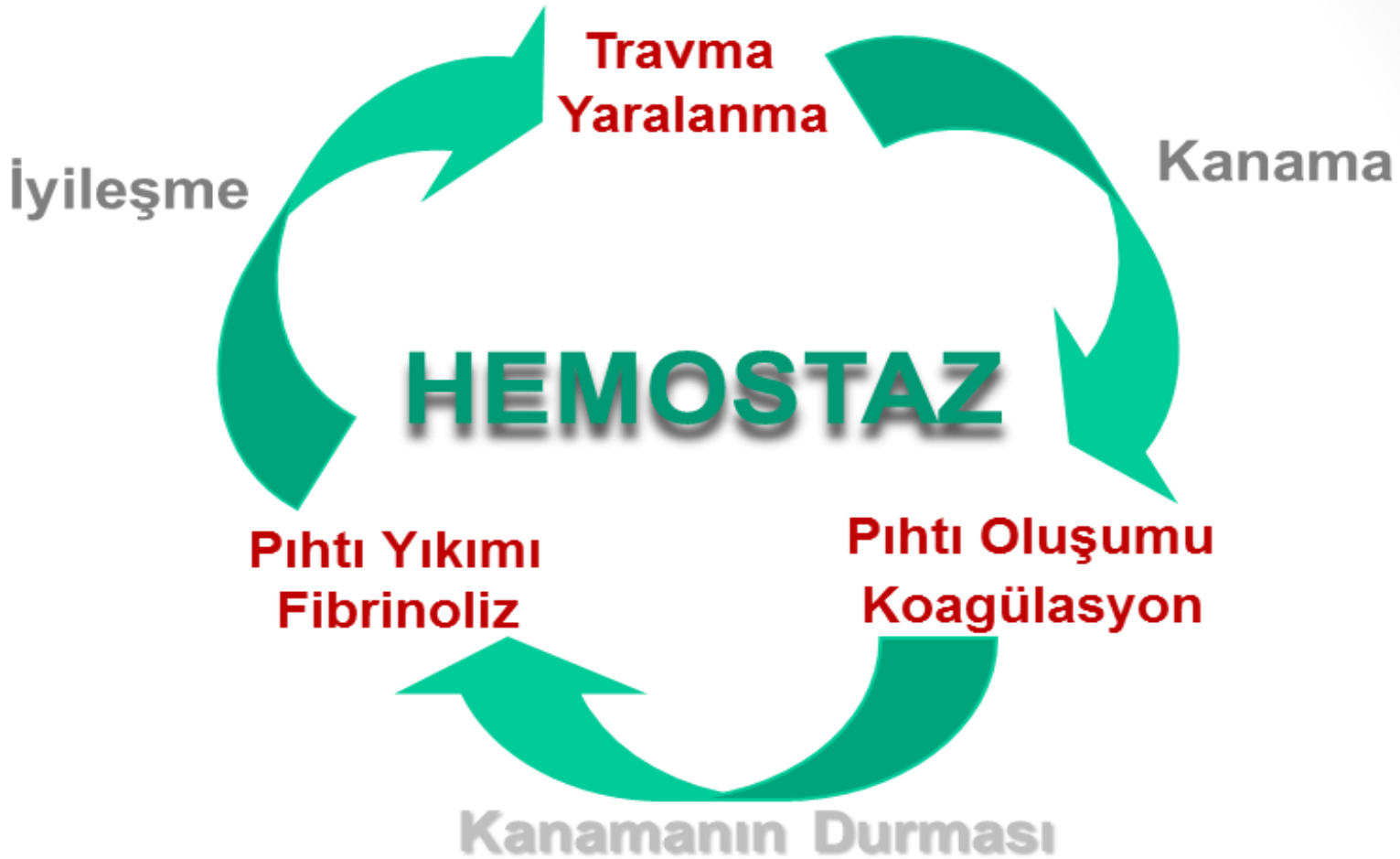


VISKOELASTİK HEMOSTATİK TAHLİL (TEG, ROTEM)



Uzm. Dr. Hasan GÜMÜŞBOĞA
Şehitkamil Devlet Hastanesi/Acil Servis
0 505 873 20 48

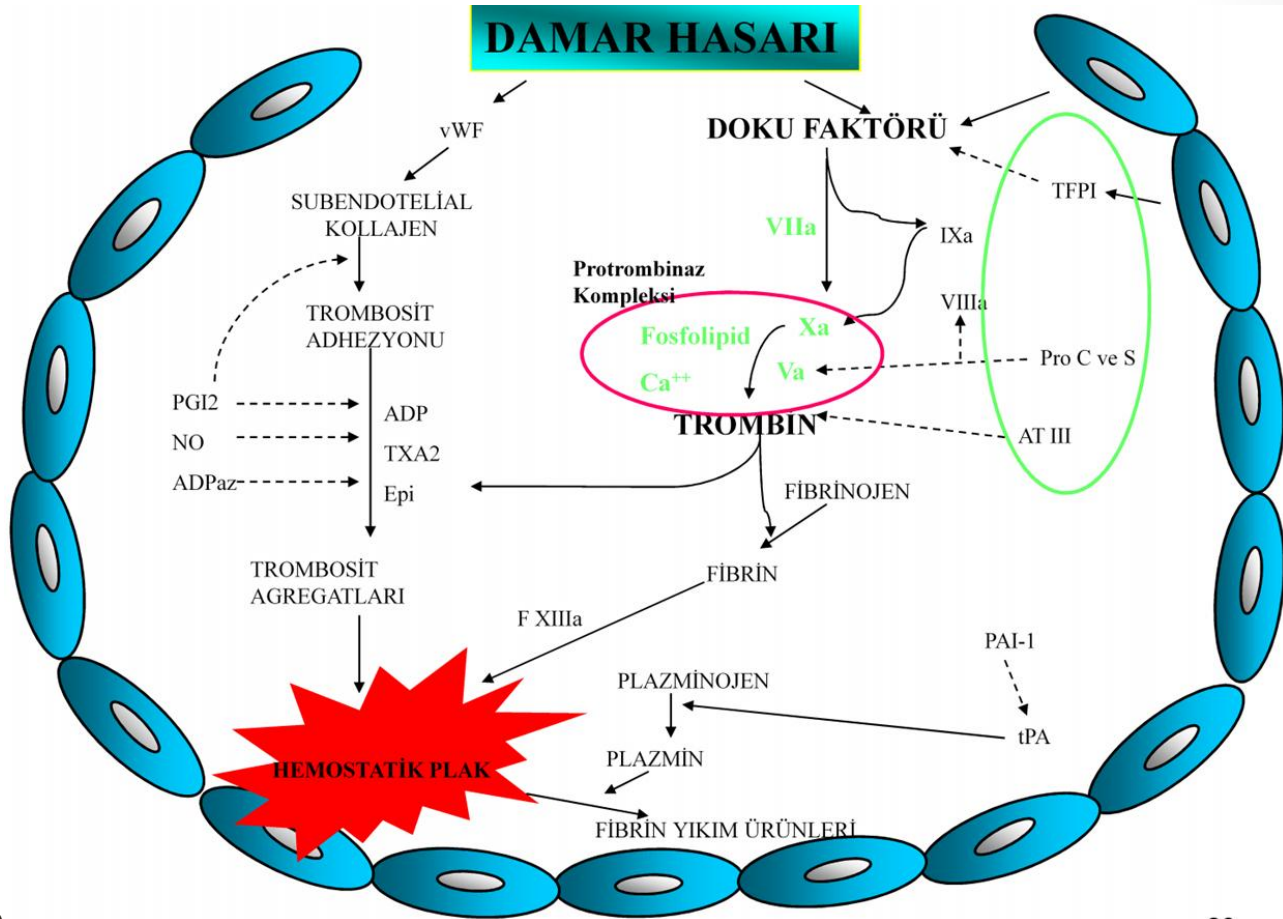


VAZOKONSTRÜKSİYON-PRİMER HEMOSTAZ-SECONDER HEMOSTAZ-FİBRİNOLİZ

KOAGÜLASYON FAKTÖRLERİ

- I (fibrinojen)
- II (protrombin)
- Doku faktörü (TF)
- Kalsiyum
- V (proakselerin, labil faktör)
- VII (prokonvertin, stabil faktör)
- VIII (Antihemofilik faktör-A)
- IX (Antihemofilik faktör-B)
- X (Stuart-Prover faktörü)
- XI (Plazma tromboplastin öncülü)
- XII (Hageman faktörü)
- XIII (fibrini stabilize eden faktör)
- von Willebrand Faktör
- Prekallikrein (Fletcher faktörü)
- Yüksek moleküler ağırlıklı kininogen
- Fibronektin
- Antitrombin III (Antitrombin)
- Heparin kofaktör II
- Protein C
- Protein S
- Protein Z
- Protein Z-ilişkili proteaz inhibitörü (ZPi)
- Plazminojen
- Alfa 2-antiplazmin
- Doku plazminojen aktivatörü (tPA)
- Ürokinaz
- Plazminojen aktivatör-1 (PAI-1)
- Plazminojen aktivatör-2 (PAI-2)

Damar endotel hücreleri, trombositler, von Willebrand faktör, doku faktörü, pıhtılaşma proteinleri, fibrinolitik sistem, antikoagülan proteinler hemostaz sisteminin ana elemanlarını oluştururlar!!



- **protrombin zamanı (PT)**
 - **uluslararası normalleştirilmiş oran (INR)**
 - **aktifte parsiyel tromboplastin zamanı (aPTT)**
- **trombosit sayısı**
 - **fibrinojen konsantrasyonu**
- **D-dimer seviyesi**
- **kanama zamanı (BT)**

- Faktör V
- C ve S proteinleri
- anti-trombin III
- antikardiyolipin antikorları
- protrombin gen mutasyonu

• ...



Thromboelastography (TEG®)
Rotation thromboelastometry (RoTEM®)



TEG



ROTEM Delta

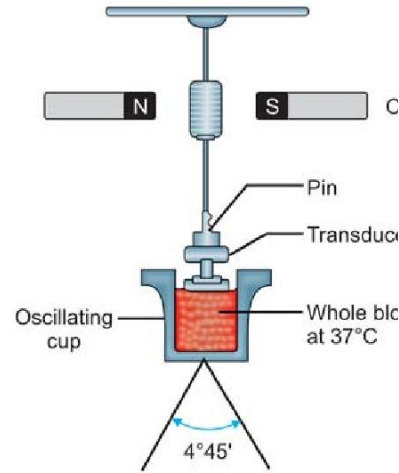


THROMBOELASTOGRAPHY



***Dr. Hellmut Hartert-1948-ALMANYA
Heidelberg Üniversitesi***

- Tromboelastogram (TEG) ölçümleri küçük, taşınabilir ve kısa sürede sonuç veren (yaklaşık 30 dakika) bir cihaz ile yapılmaktadır.



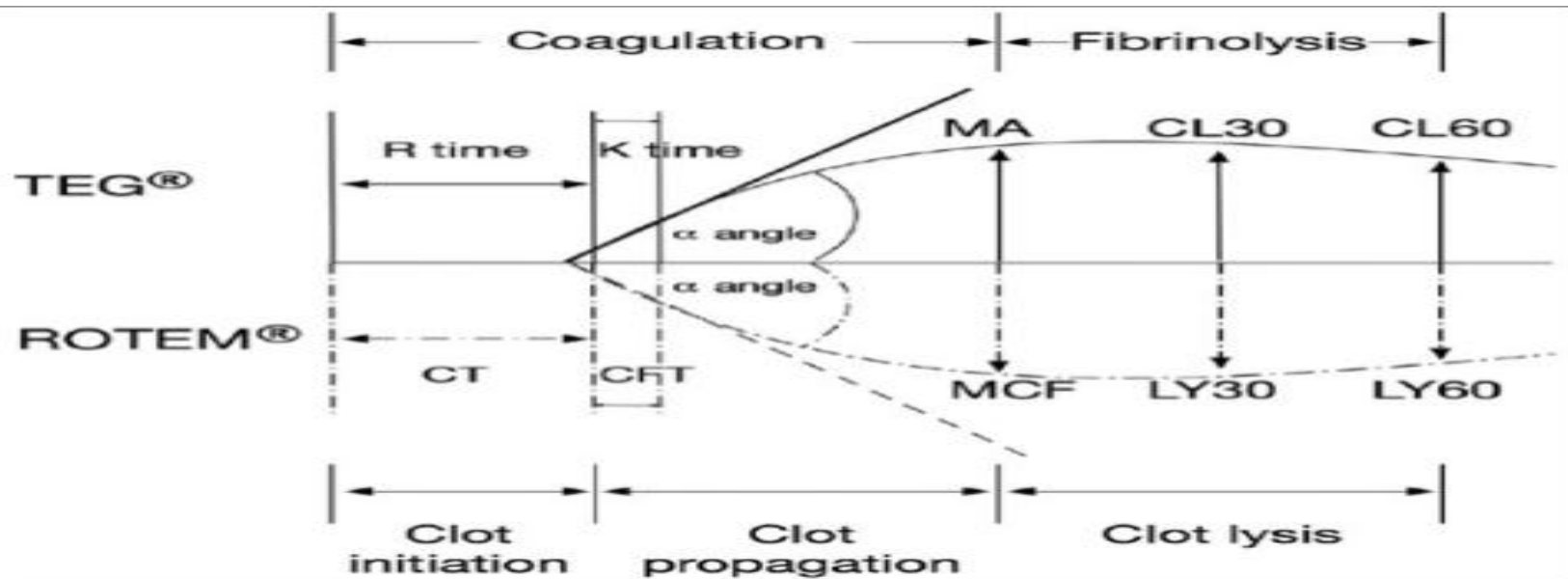
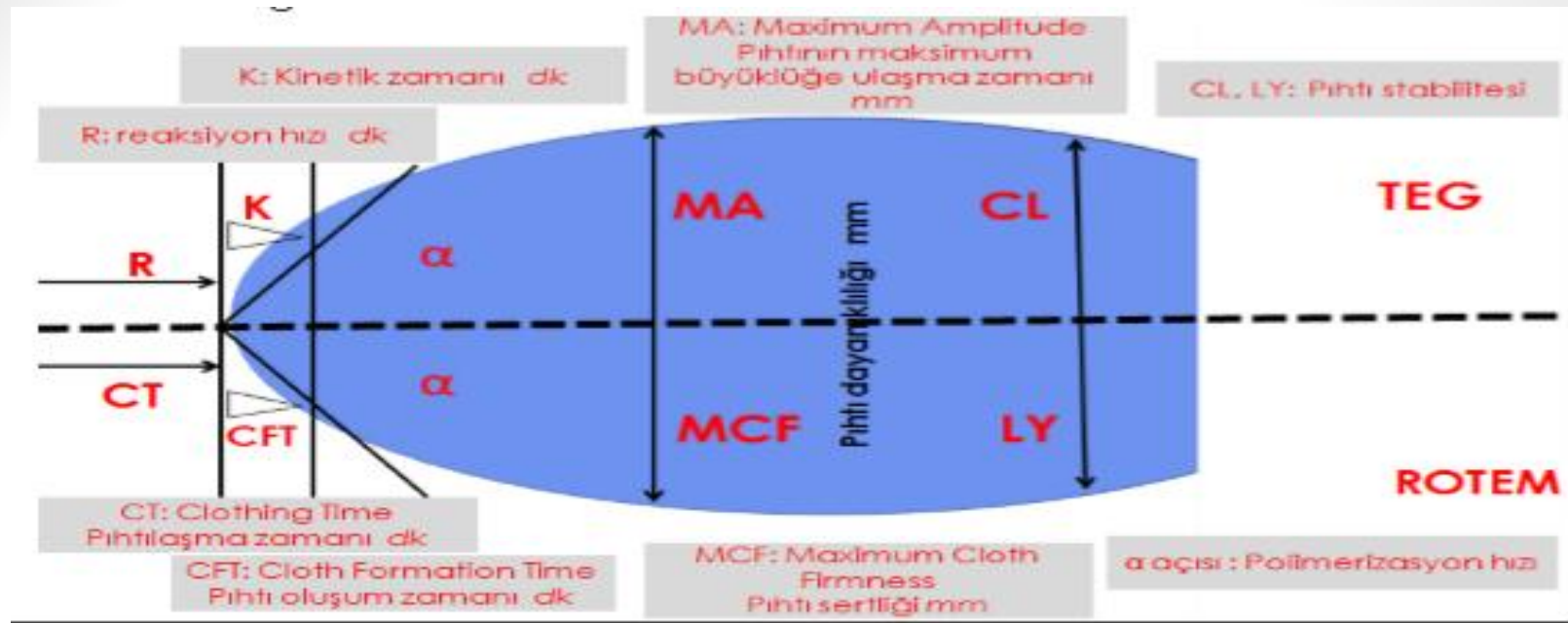
- Elektromanyetik transdüsör
- Silindirik küvet
 - İğne
 - Bilgisayar

- ✓ Aktivatörler
- ✓ Heparinaz
- ✓ Trombosit blokörleri
- ✓ Antifibrinolitik ilaçlar

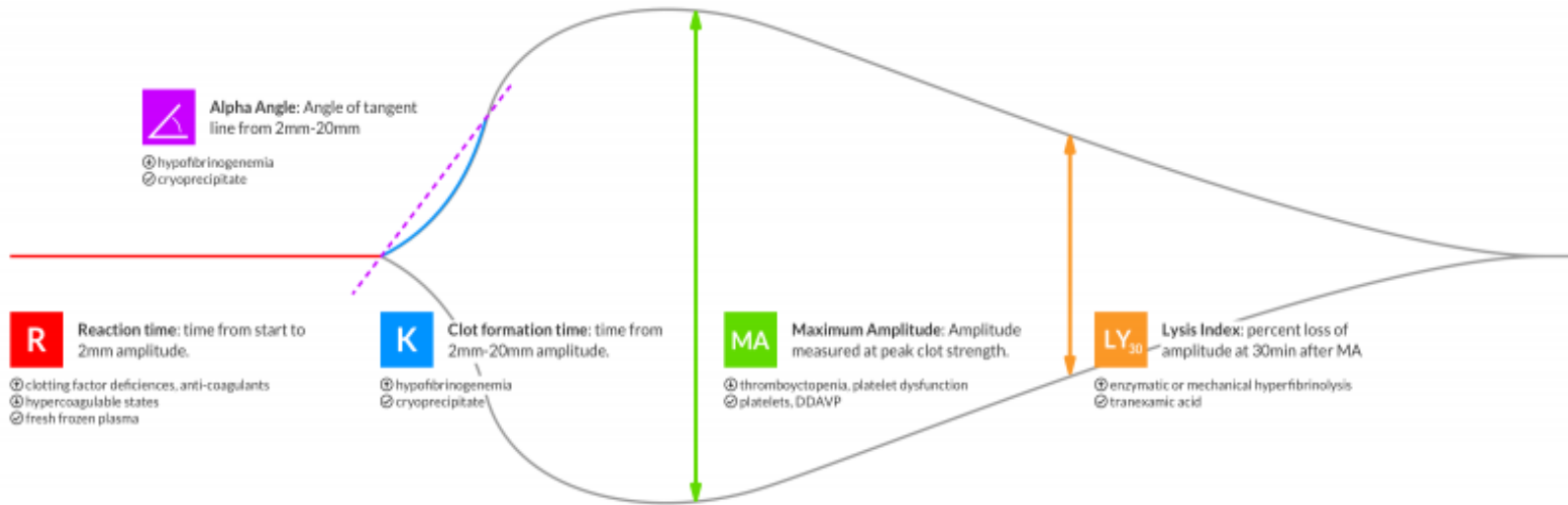
ROTEM

1. NATEM
2. INTEM
3. EXTEM
4. FIBTEM
5. APTEM
6. HEPTEM





- **R zamanı:** *Reaksiyon zamanı* anlamına gelir ve ölçüme başladığı andan *iki eğri arasındaki mesafenin 1 mm'ye ulaşmasına kadar geçen süreyi* göstermektedir.
- **K zamanı:** Pıhtı oluşum zamanı anlamına gelir ve pıhtının 20 mm'lik genliğe ulaşması için geçen zamanı gösterir. *Hem trombin aktivitesi, hem de fibrin oluşumu ile ilgilidir.*
- **Alfa açısı:** Yatay eksenden ayrılan eğriden çizilen tanjant çizgisi ile yatay eksen arasında olan açıdır. *Pıhtının maksimum güce ulaşma hızını gösterir.*
- **Maksimum amplitüd veya genlik(MA):** Pıhtının *maksimum genliğini veya maksimum elastikiyetini* yansıtır. Daha çok *trombosit sayısı, trombosit fonksiyonları ve fibrinojen seviyesi* ile ilgilidir.
- **LY30 ve LY60 değerleri:** Maksimum genlik noktasına ulaştıktan sonra *30. ve 60. dakika pıhtının genliğindeki azalmayı* ifade eder.





Normal

R,K,MA_Angle = Normal



Anticoagulants/hemophilia

Factor Deficiency

R,K = Prolonged;

MA_Angle = Decreased



Platelet Blockers

Thrombocytopenia/

Thrombocytopathy

R ~ Normal; K = Prolonged;

MA = Decreased



Fibrinolysis (UK, SK, or t-PA)

Presence of t-PA

R ~ Normal;

MA = Continuous decrease

LY30 > 7.5%; WBCL130 < 97.5%;

Ly60 > 15.0%; WBCL60 < 85%



Hypercoagulation

R,K = Decreased;

MA_Angle = Increased



D.I.C

Stage 1

Hypercoagulable state with
secondary fibrinolysis



Stage 2

Hypocoagulable state

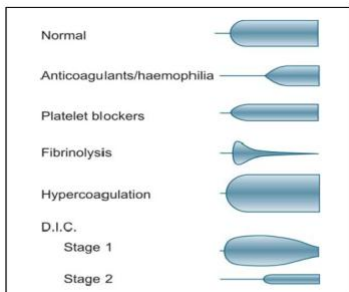
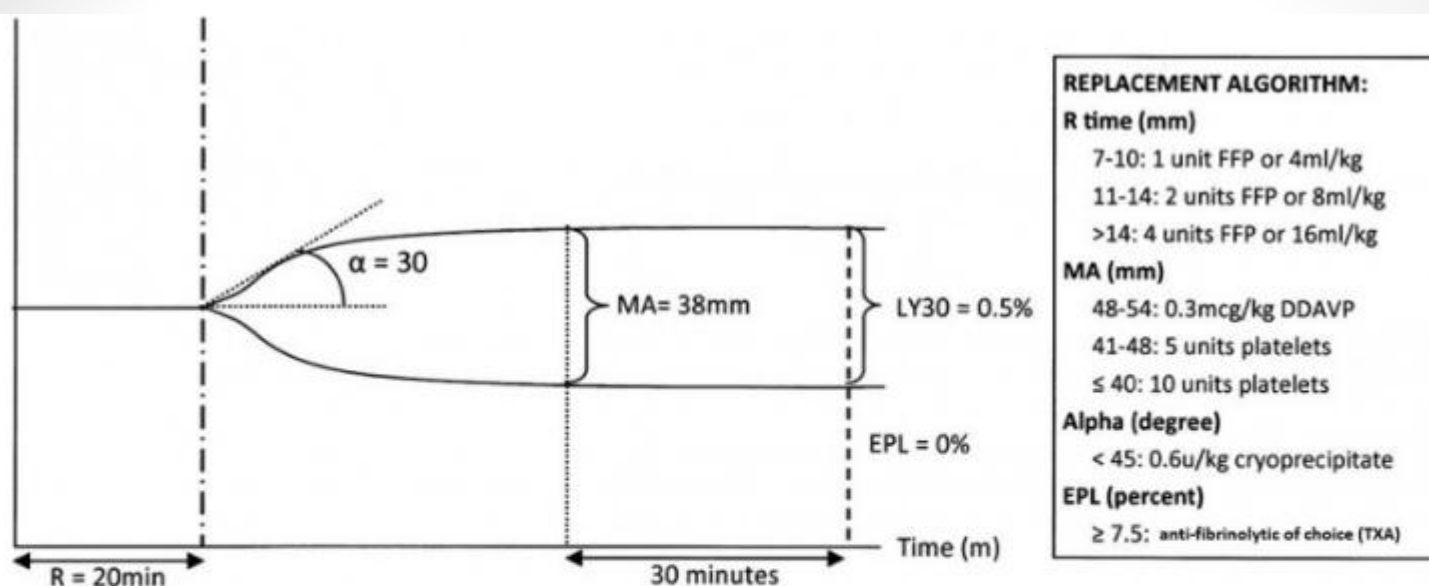


Figure 6. Characteristic TEG Waveforms⁷

TEG Value	Normal*	Description	Measures
TEG-ACT (rapid)	80 - 140 sec	"Activated clotting time" to initial fibrin formation	clotting factors (extrinsic/intrinsic pathways)
R time (conventional)	5.0 - 10.0 min	"Reaction time" to initial fibrin formation	clotting factors (intrinsic pathway)
K time	1.0 - 3.0 min	"Kinetic time" for fibrin cross linkage to reach 20 mm clot strength	fibrinogen, platelet number
α angle	53.0 - 72.0 degrees	Angle from baseline to slop of tracing that represents clot formation	fibrinogen, platelet number
MA	50.0 - 70.0 mm	Maximum amplitude of tracing	platelet number and function
G value	5.3 - 12.4 dynes/cm ²	Calculated value of clot strength	entire coagulation cascade
LY 30	0 - 3%	Clot lysis at 30 minutes following MA	fibrinolysis

Figure 4. Interpretation of a TEG³ Referans değerleri?



TEG Value	Transfuse
TEG-ACT > 140	FFP
R time > 10	FFP
K time > 3	cryoprecipitate
α angle < 53	cryoprecipitate +/- platelets
MA < 50	platelets
LY30 > 3%	tranexamic acid

Figure 5. Recommended Transfusion Strategies³

LİTERATÜR???



Quality assurance and quality control of thrombelastography and rotational Thromboelastometry: the UK NEQAS for blood coagulation experience.

Kitchen DP¹, Kitchen S, Jennings I, Woods T, Walker I.

⊕ Author information

Abstract

Global hemostasis devices are currently being employed in operating rooms to assess the bleeding risk and outcomes for patients undergoing surgery. Two devices currently available are the TEG (Thromboelastograph; Haemoscope Corp., Niles, IL) and the ROTEM (Rotation Thromboelastometer; Pentapharm GmbH, Munich, Germany). Both measure the speed of clot formation, the strength of the clot when formed, and clot fibrinolysis kinetics. The two devices use different parameters so no cross comparisons of results can be made. The devices are usually operated by a member of the operating team and not a laboratory scientist; thus their testing and performance is generally not laboratory controlled, despite quality control being required to ensure reliable results. The UK National External Quality Assessment Scheme (NEQAS) for Blood Coagulation has undertaken a series of exercises evaluating the provision of External Quality Assessment (EQA) material for these devices. A series of four studies have taken place using lyophilized plasmas as the test material. Up to 18 TEG users and 10 ROTEM users have been involved in testing two samples per study, for a total of eight samples tested. The samples were normal plasmas, factor VIII or XI deficient samples, or normal plasmas spiked with heparin. The precision of the tests varied greatly for both devices, with coefficients of variances ranging from 7.1 to 39.9% for TEG and 7.0 to 83.6% for ROTEM. Some centers returned results that were sufficiently different from those obtained by other participants to predict alterations in patient management decisions. Our data indicate that regular EQA/proficiency testing is needed for these devices.

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[Indexed for MEDLINE]

17 randomize kontrollü çalışmanın (RKÇ) yapılan bir meta-analizi, TEG'in kalp cerrahisi hastalarında postoperatif kanama nedeniyle kan ürünü transfüzyonlarını ve yeniden cerrahi oranlarını azalttığını göstermiştir

Point-of-care thromboelastography/thromboelastometry-based coagulation management in cardiac surgery: a meta-analysis of 8332 patients.

Deppe AC¹, Weber C², Zimmermann J², Kuhn EW², Slottosch I², Liakopoulos OJ², Choi YH³, Wahlers T².

✚ Author information

Abstract

OBJECTIVES: Severe bleeding related to cardiac surgery is associated with increased morbidity and mortality. Thromboelastography (TEG) and thromboelastometry (ROTEM) are point-of-care tests (POCT). Bedside ROTEM/TEG can rapidly detect changes in blood coagulation and therefore provide a goal-directed, individualized coagulation therapy. In this meta-analysis, we aimed to determine the current evidence for or against POCT-guided algorithm in patients with severe bleeding after cardiac surgery.

METHODS: We performed a meta-analysis of randomized controlled trials and observational trials retrieved from a literature search in PubMed, EMBASE, and Cochrane Library. Only trials comparing transfusion strategy guided by TEG/ROTEM with a standard of care control group undergoing cardiac surgery were included. In addition, at least one clinical outcome had to be mentioned: mortality, surgical re-exploration rate, sternal wound infection, and acute kidney injury (AKI). Also, surrogate parameters such as transfusion requirements and amount of blood loss were analyzed. The pooled treatment effects (odds ratio [OR] and 95% confidence intervals [CI]) were assessed using a fixed or random-effects model.

RESULTS: The literature search retrieved a total of 17 trials (nine randomized controlled trial and eight observational trials) involving 8332 cardiac surgery patients. POCT-guided transfusion management significantly decreased the odds for patients to receive allogeneic blood products (OR 0.63, 95% CI 0.56-0.71; $P < 0.00001$) and the re-exploration rate due to postoperative bleeding (OR 0.56, 95% CI 0.45-0.71; $P < 0.00001$). Furthermore, the incidence of postoperative AKI (OR 0.77, 95% CI 0.61-0.98; $P = 0.0278$) and thromboembolic events (OR 0.44, 95% CI 0.28-0.70; $P = 0.0006$) was significantly decreased in the TEG/ROTEM group. No statistical differences were found with regard to in-hospital mortality, cerebrovascular accident, or length of intensive care unit and hospital stay.

CONCLUSIONS: TEG/ROTEM-based coagulation management decreases the risk of allogeneic blood product exposure after cardiac surgery. Furthermore, it results in significantly lower re-exploration rate, decreased incidence of postoperative AKI, and thromboembolic events in cardiac surgery patients. Results of this meta-analysis indicate that POCT-guided transfusion therapy is superior to the current standard of care.

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Yakın zamanda yapılan bir RKÇ, EXTEM ve FIBTEM'in rehberliğinde koagülopatinin intraoperatif düzeltilmesinin, pediyatrik kalp cerrahisi hastalarında postoperatif kanamayı, kan transfüzyonlarını ve kritik bakım süresini azaltabileceğini buldu.

Thromboelastography (TEG) or rotational thromboelastometry (ROTEM) to monitor haemostatic treatment in bleeding patients: a systematic review with meta-analysis and trial sequential analysis.

Wikkelso A¹, Wetterslev J², Møller AM³, Afshari A⁴.

⊕ Author information

Abstract

Coagulopathy and severe bleeding are associated with high mortality. We evaluated haemostatic treatment guided by the functional viscoelastic haemostatic assays, thromboelastography or rotational thromboelastometry in bleeding patients. We searched for randomised, controlled trials irrespective of publication status, publication date, blinding status, outcomes published or language from date of inception to 5 January 2016 in six bibliographic databases. We included 17 trials (1493 participants), most involving cardiac surgery. Thromboelastography or rotational thromboelastometry seemed to reduce overall mortality compared to any of our comparisons (3.9% vs. 7.4%, RR (95% CI) 0.52 (0.28-0.95); $I^2 = 0\%$, 8 trials, 717 participants). However, the quality of evidence is graded as low due to the high risk of bias, heterogeneity, imprecision and low event rate. Thromboelastography or rotational thromboelastometry significantly reduced the proportion of patients transfused with red blood cells (RR (95% CI) 0.86 (0.79-0.94); $I^2 = 0\%$, 10 trials, 832 participants), fresh frozen plasma (RR (95% CI) 0.57 (0.33-0.96); $I^2 = 86\%$, 10 trials, 832 participants) and platelets (RR (95% CI) 0.73 (0.60-0.88); $I^2 = 0\%$, 10 studies, 832 participants). There was no difference in proportion needing surgical re-interventions (RR (95% CI) 0.75 (0.50-1.10); $I^2 = 0\%$, 9 trials, 887 participants). Trial sequential analysis of mortality suggests that only 54% of the required information size has been reached so far. Transfusion strategies guided by thromboelastography or rotational thromboelastometry may reduce the need for blood products in patients with bleeding, but the results are mainly based on trials of elective cardiac surgery involving cardiopulmonary bypass, with low-quality evidence.

© 2017 The Association of Anaesthetists of Great Britain and Ireland.

KEYWORDS: anaemia; coagulation; thromboelastography; transfusion mortality; causes

PMID: 28052313 DOI: [10.1111/anae.13765](https://doi.org/10.1111/anae.13765)

TEG, kalp cerrahisinde koagülopatinin tanısında standart koagülasyon testlerine kıyasla daha uygun maliyetli bir yöntemdir.

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

Nakayama Y¹, Nakajima Y², Tanaka KA³, Sessler DJ⁴, Maeda S¹, Iida J¹, Ogawa S¹, Mizobe T¹.

⊕ Author information

Abstract

BACKGROUND: Thromboelastometric evaluation of coagulation might be useful for prediction and management of bleeding after paediatric cardiac surgery. We tested the hypothesis that the use of a thromboelastometry-guided algorithm for blood product management reduces blood loss and transfusion requirements.

METHODS: We studied 78 patients undergoing paediatric cardiac surgery with cardiopulmonary bypass (CPB) for the initial 12 h after operation. Stepwise multiple linear regression was used to develop an algorithm to guide blood product transfusions. Thereafter, we randomly assigned 100 patients to conventional or algorithm-guided blood product management, and assessed bleeding and red cell transfusion requirements.

RESULTS: CPB time, post-bypass rotational thromboelastometry (ROTEM(®)) EXTEM amplitude at 10 min (A10), and FIBTEM-A10 were independently associated with chest tube drainage volume during the initial 12 h after operation. Discriminative analysis determined cut-off values of 30 mm for EXTEM-A10 and 5 mm for FIBTEM-A10, and estimated optimal intraoperative fresh-frozen plasma and platelet concentrate transfusion volumes. Thromboelastometry-guided post-bypass blood product management significantly reduced postoperative bleeding (9 vs 16 ml kg⁻¹, P<0.001) and packed red cell transfusion requirement (11 vs 23 ml kg⁻¹, P=0.005) at 12 h after surgery, and duration of critical care stay (60 vs 71 h, P=0.014).

CONCLUSIONS: Rotational thromboelastometry-guided early haemostatic intervention by rapid intraoperative correction of EXTEM-A10 and FIBTEM-A10 reduced blood loss and red cell transfusion requirements after CPB, and reduced critical care duration in paediatric cardiac surgical patients.

CLINICAL TRIAL REGISTRATION: UMIN Clinical Trials Registry UMIN000006832 (December 4, 2011).

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KEYWORDS: blood coagulation; blood coagulation tests; blood transfusion; paediatrics

PMID: 25303988 DOI: 10.1093/bja/aeu339

Yeni bir Cochrane veritabanı sistematik derlemesi, travmaya bağlı koagülopatinin tanısında TEG ve RoTEM ile PT / INR'nin doğruluğunu karşılaştırmada bulunan verileri yetersiz buldu

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

Wikkelsø A¹, Wetterslev J, Møller AM, Afshari A.

⊕ Author information

Abstract

BACKGROUND: Severe bleeding and coagulopathy are serious clinical conditions that are associated with high mortality. Thromboelastography (TEG) and thromboelastometry (ROTEM) are increasingly used to guide transfusion strategy but their roles remain disputed. This review was first published in 2011 and updated in January 2016.

OBJECTIVES: We assessed the benefits and harms of thromboelastography (TEG)-guided or thromboelastometry (ROTEM)-guided transfusion in adults and children with bleeding. We looked at various outcomes, such as overall mortality and bleeding events, conducted subgroup and sensitivity analyses, examined the role of bias, and applied trial sequential analyses (TSAs) to examine the amount of evidence gathered so far.

SEARCH METHODS: In this updated review we identified randomized controlled trials (RCTs) from the following electronic databases: Cochrane Central Register of Controlled Trials (CENTRAL; 2016, Issue 1); MEDLINE; Embase; Science Citation Index Expanded; International Web of Science; CINAHL; LILACS; and the Chinese Biomedical Literature Database (up to 5 January 2016). We contacted trial authors, authors of previous reviews, and manufacturers in the field. The original search was run in October 2010.

SELECTION CRITERIA: We included all RCTs, irrespective of blinding or language, that compared transfusion guided by TEG or ROTEM to transfusion guided by clinical judgement, guided by standard laboratory tests, or a combination. We also included interventional algorithms including both TEG or ROTEM in combination with standard laboratory tests or other devices. The primary analysis included trials on TEG or ROTEM versus any comparator.

DATA COLLECTION AND ANALYSIS: Two review authors independently abstracted data; we resolved any disagreements by discussion. We presented pooled estimates of the intervention effects on dichotomous outcomes as risk ratio (RR) with 95% confidence intervals (CIs). Due to skewed data, meta-analysis was not provided for continuous outcome data. Our primary outcome measure was all-cause mortality. We performed subgroup and sensitivity analyses to assess the effect based on the presence of coagulopathy of a TEG- or ROTEM-guided algorithm, and in adults and children on various clinical and physiological outcomes. We assessed the risk of bias through assessment of trial methodological components and the risk of random error through TSA.

Özellikle kalp cerrahisi hastaları olmak üzere toplam 776 katılımcının olduğu 9 RKÇ, TEG veya RoTEM kullanıldığında mortalitede bir düşüş olmadan kanamanın azaldığını tespit etmiş.

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.

Veigas PV¹, Callum J², Rizoli S³, Nascimento B⁴, da Luz LT⁵.

➤ Author information

Abstract

INTRODUCTION: Viscoelastic assays have been promoted as an improvement over traditional coagulation tests in the management of trauma patients. Rotational thromboelastometry (ROTEM®) has been used to diagnose coagulopathy and guide hemostatic therapy in trauma. This systematic review of clinical studies in trauma investigates the ROTEM® parameters thresholds used for the diagnosing coagulopathy, predicting and guiding transfusion and predicting mortality.

METHODS: Systematic literature search was performed using MEDLINE, EMBASE and Cochrane databases. We included studies without restricting year of publication, language or geographic location. Original studies reporting the thresholds of ROTEM® parameters in the diagnosis or management of coagulopathy in trauma patients were included. Data on patient demographics, measures of coagulopathy, transfusion and mortality were extracted. We reported our findings according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. Quality assessment and risk of bias were performed using Newcastle Ottawa Scale (NOS) and the quality assessment of diagnostic accuracy studies (QUADAS-2) tools, respectively.

RESULTS: A total of 13 observational studies involving 2835 adult trauma patients met the inclusion criteria. Nine studies were prospective and four were retrospective. There were no randomized controlled trials. The quality of the included studies was moderate (mean NOS 5.92, standard deviation 0.26). Using QUADAS-2, only 1 study (7.6 %) had low risk of bias in all domains, and 9 studies (69.2 %) had low risk of applicability concerns. Outcomes from 13 studies were grouped into three categories: diagnosis of coagulopathy (n = 10), prediction of massive transfusion or transfusion guidance (n = 6) and prediction of mortality (n = 6). Overall, specific ROTEM® parameters measured (clot amplitude and lysis) in the extrinsically activated test (EXTEM) and the fibrin-based extrinsically activated test (FIBTEM) were consistently associated with the diagnosis of coagulopathy, increased risk of bleeding and massive transfusion, and prediction of mortality. Presence of hyperfibrinolysis by ROTEM® was associated with increased mortality.

CONCLUSIONS: Most of the evidence indicates that abnormal EXTEM and FIBTEM clot amplitude (CA5, CA10) or maximal clot firmness (MCF) diagnose coagulopathy, and predict blood transfusion and mortality. The presence of fibrinolysis (abnormal lysis index [LI30] or maximum lysis [ML]) was also associated with mortality. ROTEM® thus, may be of value in the early management of trauma patients.

KEYWORDS: Acute trauma coagulopathy; Bleeding; Threshold; Thromboelastometry; Transfusion

PMID: 27716278 PMCID: PMC5048662 DOI: 10.1186/s13049-016-0308-2

Küçük bir RKÇ, TEG'in ECMO sırasında antikoagülasyonu aPTT'ye kıyasla daha iyi yönlendirerek heparin dozunu azalttığını göstermiştir.

Thromboelastography-based anticoagulation management during extracorporeal membrane oxygenation: a safety and feasibility pilot study.

Panigada M¹, E Iapichino G², Brioni M², Panarello G³, Protti A⁴, Grasselli G⁴, Occhipinti G³, Novembrino C⁵, Consonni D⁶, Arcadipane A³, Gattinoni L⁷, Pesenti A^{4,2}.

Author information

Abstract

BACKGROUND: There is no consensus on the management of anticoagulation during extracorporeal membrane oxygenation (ECMO). ECMO is currently burdened by a high rate of hemostatic complications, possibly associated with inadequate monitoring of heparin anticoagulation. This study aims to assess the safety and feasibility of an anticoagulation protocol for patients undergoing ECMO based on thromboelastography (TEG) as opposed to an activated partial thromboplastin time (aPTT)-based protocol.

METHODS: We performed a multicenter, randomized, controlled trial in two academic tertiary care centers. Adult patients with acute respiratory failure treated with veno-venous ECMO were randomized to manage heparin anticoagulation using a TEG-based protocol (target 16-24 min of the R parameter, TEG group) or a standard of care aPTT-based protocol (target 1.5-2 of aPTT ratio, aPTT group). Primary outcomes were safety and feasibility of the study protocol.

RESULTS: Forty-two patients were enrolled: 21 were randomized to the TEG group and 21 to the aPTT group. Duration of ECMO was similar in the two groups (9 (7-16) days in the TEG group and 11 (4-17) days in the aPTT group, $p = 0.74$). Heparin dosing was lower in the TEG group compared to the aPTT group (11.7 (9.5-15.3) IU/kg/h vs. 15.7 (10.9-21.3) IU/kg/h, respectively, $p = 0.03$). Safety parameters, assessed as number of hemorrhagic or thrombotic events and transfusions given, were not different between the two study groups. As for the feasibility, the TEG-based protocol triggered heparin infusion rate adjustments more frequently ($p < 0.01$) and results were less frequently in the target range compared to the aPTT-based protocol ($p < 0.001$). Number of prescribed TEG or aPTT controls (according to study groups) and protocol violations were not different between the study groups.

CONCLUSIONS: TEG seems to be safely used to guide anticoagulation management during ECMO. Its use was associated with the administration of lower heparin doses compared to a standard of care aPTT-based protocol. Trial registration ClinicalTrials.gov, October 22, 2014. Identifier: [NCT02271126](https://clinicaltrials.gov/ct2/show/study/NCT02271126).

KEYWORDS: Anticoagulation; Extracorporeal membrane oxygenation; Hemorrhage; Heparin; Thromboelastography; Thrombosis

TEG , cerrahi hastalarda klopidoğrel ve aspirine bağılı trombosit inhibisyonunu tespit edebilir.

A novel thromboelastographic score to identify overt disseminated intravascular coagulation resulting in a hypocoagulable state.

Sharma P¹, Saxena R.

⊕ Author information

Abstract

Thromboelastography (TEM) yields a multitude of data that are complicated to analyze. We evaluated its value in identification of global coagulopathy in overt disseminated intravascular coagulation (DIC). We studied 21 patients, each with International Society for Haemostasis and Thrombosis scores of 5 or more (compatible with overt DIC) and less than 5 (suggestive of nonovert DIC), who underwent whole blood nonadditive TEM. A TEM score based on the reaction and kappa times, alpha angle, and maximum amplitude was defined as the total number of TEM parameters deranged in the direction of hypocoagulability. The TEM score at a cutoff of 2 or more achieved sensitivity of 95.2%, specificity of 81.0%, and the highest receiver operating characteristic area under the curve of all parameters of 0.957 for identifying overt DIC. Individual TEM parameters correlated variably with conventional tests. Their combination into a cohesive TEM score possibly better captured the multiple hemostatic derangements occurring in DIC. The TEM score may bring objectivity to the analysis of TEM data.

PMID: 20551273 DOI: [10.1309/AJCPPZ4J8CAFYDVM](https://doi.org/10.1309/AJCPPZ4J8CAFYDVM)

[Indexed for MEDLINE]

TEG, intrakraniyal kanama ve hematoma büyümesi olan hastalarda olası koagülopatiyi tespit edebilir

Rebalanced hemostasis in patients with liver disease: evidence and clinical consequences.

Lisman T¹, Porte RJ.

⊕ Author information

Abstract

Patients with liver disease frequently acquire a complex disorder of hemostasis secondary to their disease. Routine laboratory tests such as the prothrombin time and the platelet count are frequently abnormal and point to a hypocoagulable state. With more sophisticated laboratory tests it has been shown that patients with liver disease may be in hemostatic balance as a result of concomitant changes in both pro- and antihemostatic pathways. Clinically, this rebalanced hemostatic system is reflected by the large proportion of patients with liver disease who can undergo major surgery without any requirement for blood product transfusion. However, the hemostatic balance in the patient with liver disease is relatively unstable as evidenced by the occurrence of both bleeding and thrombotic complications in a significant proportion of patients. Although it is still common practice to prophylactically correct hemostatic abnormalities in patients with liver disease before invasive procedures by administration of blood products guided by the prothrombin time and platelet count, we believe that this policy is not evidence-based. In this article, we will provide arguments against the traditional concept that patients with liver failure have a hemostasis-related bleeding tendency. Consequences of these new insights for hemostatic management will be discussed.

PMID: 20400681 DOI: [10.1182/blood-2010-02-261891](https://doi.org/10.1182/blood-2010-02-261891)

TEG / RoTEM, karaciğer hastalığı olan hastalarda kanama riski konusunda konvansiyonel pıhtılaşma testlerinden daha iyi bir fikir verebilir

Clinical Utility of Viscoelastic Tests of Coagulation (TEG/ROTEM) in Patients with Liver Disease and during Liver Transplantation.

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Abstract

The concept that patients with stable liver disease are at an increased risk of bleeding, based solely on abnormalities of conventional coagulation tests such as prothrombin time (PT) and international normalized ratio (INR), is now recognized to be an overly simplistic interpretation of an extremely complex situation. These tests are in fact very poor predictors of bleeding in patients with liver disease who undergo invasive or surgical procedures. Commercially available whole blood viscoelastic tests (thromboelastography [TEG] and thromboelastometry [ROTEM]) evaluate the kinetics of coagulation from initial clot formation to final clot strength. These dynamic tests provide a composite picture reflecting the interaction of plasma, blood cells, and platelets, and more closely reflect the situation in vivo than do PT/INR, which are performed on plasma samples and measure isolated end points. Despite prolonged PT/INR and low platelet counts, viscoelastic tests are within normal range in many patients with both acute and chronic liver disease, commensurate with the concept of rebalanced hemostasis, and in keeping with the fact that an increasing number of these patients undergo liver transplantation without the need for blood or blood products. In addition, these tests reveal important additional information, such as the presence of hypercoagulability and a prothrombotic state, and also information about the presence of endogenous heparinoids associated with vascular endothelial damage, due to sepsis or acute inflammation. This review provides an overview of the current literature on the potential clinical utility of viscoelastic tests of coagulation in patients with liver disease.

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EXTEM(RoTEM), karaciğer nakli hastalarında intraoperatif koagülopatinin saptanmasında yardımcı bulunmuştur

Gelecek Yönler?

Antikoagülasyon ve Antiplatelet Tedavisi Rehberliği

- ✓ Figueiredo, S., Vigué, B., Benhamou, D., & Duranteau, J. (2013). Emergency reversal of heparin overdose in a neurosurgical patient guided by thromboelastography. *British journal of anaesthesia*, 111(2), 303-304.
- ✓ Favaloro, E. J., & Lippi, G. (2015, March). Laboratory Testing in the era of direct or non-vitamin k antagonist oral anticoagulants: a practical guide to measuring their activity and avoiding diagnostic errors. In *Seminars in thrombosis and hemostasis*(Vol. 41, No. 02, pp. 208-227). Thieme Medical Publishers.
- ✓ Rose, A. J., Ozonoff, A., Grant, R. W., Henault, L. E., & Hylek, E. M. (2009). Epidemiology of subtherapeutic anticoagulation in the United States. *Circulation: Cardiovascular Quality and Outcomes*, 2(6), 591-597.
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Venöz Tromboembolinin Önlenmesi

- ✓ Van, P. Y., Cho, S. D., Underwood, S. J., Morris, M. S., Watters, J. M., & Schreiber, M. A. (2009). Thrombelastography versus AntiFactor Xa levels in the assessment of prophylactic-dose enoxaparin in critically ill patients. *Journal of Trauma and Acute Care Surgery*, 66(6), 1509-1517.
- ✓ Parameswaran, A., Krishnamoorthy, V. P., Oommen, A. T., Jasper, A., Korula, R. J., Nair, S. C., & Poonnoose, P. M. (2016). Is pre-operative assessment of coagulation profile with Thrombelastography (TEG) useful in predicting venous thromboembolism (VTE) following orthopaedic surgery?. *Journal of clinical orthopaedics and trauma*, 7, 225-229.
- ✓ Brill, J. B., Badiie, J., Zander, A. L., Wallace, J. D., Lewis, P. R., Sise, M. J., ... & Shackford, S. R. (2017). The rate of deep vein thrombosis doubles in trauma patients with hypercoagulable thromboelastography. *Journal of Trauma and Acute Care Surgery*, 83(3), 413-419.
- ✓ Toukh, M., Siemens, D. R., Black, A., Robb, S., Leveridge, M., Graham, C. H., & Othman, M. (2014). Thromboelastography identifies hypercoagulability and predicts thromboembolic complications in patients with prostate cancer. *Thrombosis research*, 133(1), 88-95.

- *Lack of evidence suggests that these tests currently should be used **ONLY FOR RESEARCH** purposes in regards to trauma-induced coagulopathy.*



Kanıt eksikliği, bu testlerin şu anda travmaya bağlı koagülopati ile ilgili **SADECE ARAŞTIRMA İÇİN** kullanılması gerektiğini göstermektedir

Klinik Kılavuzlar?

- **Kalp cerrahisi hastalarında** hemostazın saptanmasına, yönetilmesine ve izlenmesine yardımcı olmak için NICE rehberleri tarafından tromboelastografi önerilmektedir (**NICE rehberleri, 2014**).
- **Diğer klinik kılavuzlar**, yüksek kaliteli kanıtların bulunmamasından dolayı, diğer ortamlarda kullanım için TEG'i kesinlikle **önermemektedir**.
- **Avrupa Anesteziyoloji Derneği'nin** yakın zamanda güncellenen kılavuzları, **perioperatif kanamanın yönetimine** rehberlik etmek ve **düşük kanıt düzeyine rağmen ciddi peripartum kanamayı yönetmek için** viskoelastik hemostatik analizleri (**TEG / RoTEM**) **önermiştir**.

Sonuç olarak

TEG ve ROTEM gibi viskoelastik hemostatik analizlerin kullanılması;

- TDP, TS ve kriyopresipitat gibi yüksek hacimli, komplikasyon riski yüksek kan ürünlerinin kullanımını azaltmakta,
- Hedefe yönelik dengeli transfüzyon imkanı sağlamakta,
- **Ve bu durumun mortalite üzerine ciddi katkıları bulunmaktadır.**

Ancak

- **Travma hastalarında standart bir algoritma oluşturulamamıştır!!**
- **Kalp cerrahisinde yapılan randomize klinik çalışmalarda gösterildiği gibi travma hastalarında da bir çok yeni randomize çalışmaya ihtiyaç duyulmaktadır!!**



Teşekkürler!