Thromboelastometry vs. thromboelastography

ROTEM® can discriminate between dilutional coagulopathy and thrombocytopenia. ROTEM® is faster than TEG®
Diagnostic Performance and Therapeutic Consequence of Thromboelastometry Activated by Kaolin versus a Panel of specific reagents

TEG® Platelet Mapping test also can be used on ROTEM®
Evaluation of the Platelet Mapping™ assay on rotational thromboelastometry ROTEM®
Background

Rotational thromboelastometry ROTEM® is available as point-of-care coagulation monitoring in an increasing number of European operating theatres and emergency rooms. The Platelet Mapping™ Assay has been described as a platelet aggregation assay for thromboelastography TEG®. The aim of this experimental trial was to evaluate feasibility of the Platelet Mapping™ Assay on the ROTEM® test system.

Ex vivo study
- Whole blood was drawn from 22 adult volunteers and patients with and without antiplatelet medication.
- Platelet aggregability was determined in three whole blood assays: the Platelet Mapping™ Assay using both activators arachidonic acid (AA) and adenosine diphosphate (ADP) on TEG®, Haemostasis Analyser 5000, its adapted version on ROTEM® gamma, and the multiple electrode impedance aggregometer Multiplate®.
- Tests were performed in duplicates simultaneously on the three test devices.
- The Platelet Mapping™ Assay combines three viscoelastic measurements involving various reagents and preparation steps.
- As the conventional blood volume is 360 µl in the TEG® and 300 µl in ROTEM® we adapted to the total test volume accordingly.
- Main parameter documented was the maximum amplitude (MA) in the TEG® and the maximum clot firmness (MCF) in the ROTEM®.
- Percent aggregation inhibition results were plotted in a linear regression analysis and correlation was estimated.
- Sensitivity and specificity for detecting antiplatelet medication were determined.
- Overall correlation were statistically with an $r^2=0.83$ in AA-activated and an $r^2=0.82$ in ADP-activated Platelet Mapping™ Assay.

Study design

- AA-activated tests and the Multiplate® analysis identified aspirin-inhibition in 86% and 100%, respectively.
- ADP-activated tests and the Multiplate® analysis identified clopidogrel-inhibition in 67% and 89%, respectively.
- Specificity was low both in ROTEM® and TEG®.
- Correlation between Platelet Mapping™ Assay performed on ROTEM® and TEG® in patients on clopidogrel and aspirin were good and highly significant.
- The Platelet Mapping™ Assay can be performed on the ROTEM®.

Results

Coagulation, platelets, platelet aggregation, point-of-care coagulation monitoring, ROTEM®, POC

"The study demonstrates that the Platelet Mapping™ Assay designed for TEG® can be run on the ROTEM®. This information on the feasibility of performing the Platelet Mapping™ Assay on the ROTEM® is important for the many ROTEM® users who are well aware of the diagnostic gap of this viscoelastic test in terms of platelet function monitoring." "The correlation between Platelet Mapping™ Assay performed on ROTEM® and TEG® ($r^2=0.825$) of all available values from all patients and volunteers obtained were comparable with the correlation between optic aggregometry and Multiplate® analyses before and after clopidogrel treatment ($r^2=0.71$)." "Diagnostic accuracy of this assay for the detection of platelet inhibition treatment by clopidogrel, aspirin, and diclofenac is inadequate and inferior to multiple electrode aggregometry using Multiplate®."

Conclusions

First publication
Thromboelastography or thromboelastometry (TEG®/ROTEM®) has become a commonly used guidance tool in the management of transfusion therapy and haemostatic intervention. Different algorithms are used; one based on the use of standard kaolin activated assay, while another uses a panel of different assays. Initial reports suggest considerable divergence in transfusion outcomes and it may be speculated that differences in diagnostic performance of the applied thromboelastographic assays may contribute to the disparity observed. This study aimed to investigate the diagnostic performance of kaolin-activated whole blood (WB) against a panel of extrinsic activated WB, intrinsic activated WB, a fibrinogen assay, aprotinin-treated WB, and heparinsaseneutralized WB in disclosing isolated coagulopathies of dilutional coagulopathy, thrombocytopenia, hyperfibrinolysis, and heparin. Furthermore, we attempted to evaluate the time spent from start of analysis until diagnostic data were available; eventually, diagnostic conclusion and derived treatment strategies were compared based on two published algorithms.

**Background**

1. **In vitro study**
   - Blood samples were drawn from 11 healthy adults into citrated plastic tubes.
   - In vitro development of dilutional coagulopathy, thrombocytopenia, hyperfibrinolysis and heparin contamination.
   - Continuous clot formation profiles were recorded using ROTEM® delta haemostasis analyzers (Tem International GmbH, Munich, Germany). A maximum runtime of 60 minutes was applied.
   - The coagulation was activated with kaolin (Haemonetics, Niles, IL, USA) and a panel of assays consisting of INTEM, EXTEM, FIBTEM, APTEM and HEPTEM (Tem International GmbH).

2. **Comparison of two published treatment algorithms**
   Two recently published transfusion protocols applying kaolin activation (1) or a panel of TEM-reagents (2) were selected for comparison of diagnostic strategies and consequent first line choices of hemostatic intervention. It has been demonstrated that the TEG® and ROTEM® provide similar data when activated with the same exogenous activator (5). Therefore, it was considered feasible to evaluate the therapeutic outcome of a kaolin activated treatment algorithm, based on data obtained from a ROTEM® coagulation analyzer.

**Study design**

- Kaolin-activated whole blood showed no differences between dilutional coagulopathy and thrombocytopenia
- Hyperfibrinolysis specifically disclosed an increased maximum lysis and heparin induced a distinctly prolonged Clotting time.
- The coagulopathies were readily distinguishable using a panel of TEM-reagents.
  - In particular, dilutional coagulopathy was separated from thrombocytopenia using FIBTEM
  - The run time of analysis to achieve diagnostic data was shorter applying a panel of TEM-reagents.
- A transfusion algorithm based on kaolin suggested platelets in case of dilutional coagulopathy, whereas an algorithm applying TEM-reagents suggested fibrinogen.

**Results**

Thrombocytopenia, kaolin, dilutional coagulopathy, thromboelastography, ROTEM®, TEG®

"In the current study, we found that using a panel of TEM-reagents provides more detailed and accurate diagnoses than using kaolin alone; the time until diagnostic data were available was shorter using a panel of TEM-reagents; and a kaolin-based algorithm would suggest the use of platelet concentrates in more cases whereas an algorithm based on TEM-reagents would lead to fibrinogen substitution in more individuals." "Monoanalysis with kaolin was unable to distinguish coagulopathies caused by dilution from that of thrombocytopenia. Algorithms based on the use of kaolin may lead to unnecessary transfusion with platelets, whereas the application of TEM-reagents may result in goal-directed fibrinogen substitution."

"In conclusion, in the ongoing development of accurate and rapid point-of-care diagnostic tests, the current study suggests that the application of a panel of supplementary assays and in particular disclosure of abnormal fibrinogen polymerization improves the quality and speed of the diagnosis."

**Conclusions**
ROTEM® benefits

Easy POC operation
- Touch screen monitor
- Intuitive software operation
- Fully automatic pipette system
- Single Use Reagents or Liquid Reagents for multiple use
- Only 300 µl blood sample volume for 1 test

Fast results
- 30-35 sec. to start measurement
- 5-10 min. to first reliable result interpretation
- 4 independent measuring channels/device

Easy differential diagnosis
- 5 standardized thromboelastometric assays and 3 standardized impedance aggregometry assays for differential diagnosis of complex coagulopathies
- Dedicated APTEM assay for hyperfibrinolysis
- EXTEM / FIBTEM to evidence fibrinogen or platelet deficiency
- ARATEM, ADPTEM and TRAPTEM to evidence platelet dysfunction
- On-board interpretation help resulted from expert consensus

Quality management
- Continuous automatic self check
- Automatic calibration
- Integrated, dedicated, secure computer
- Virus safe, closed Linux software
- Standardized automatic pipetting and automatic start of the measurement for repeatable results

Mobility
- Easily transportable on dedicated trolley

Connectivity
- Real time transmission of graphs and results on any hospital PC with Secure Viewer (included in the software)
- Up to 12 devices (on any location anywhere in the hospital) can be connected to the hospital information system