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Case Report

Clinical Profile of Patients Undergoing Thromboelastography and Its Effectiveness as A Point of Care Diagnostic Modality in Hemostasis

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ABSTRACT

Thromboelastography (TEG) is a technique for evaluating the effectiveness of whole blood coagulation. It gives a better picture in line with the cell-based model of hemostasis. Although it is increasingly used in emergency rooms, critical care units, perioperative wards and labour room, the effectiveness of this POCT is not appreciated by the medical community.

This retrospective case series analyzed the clinical characteristics of 61 patients who underwent Thromboelastography (TEG) between June 2022 and July 2023 at a tertiary care institution. The most common indication was perioperative assessment during liver transplantation, followed by cytoreductive surgery with Hyperthermic Intraperitoneal Chemotherapy (HIPEC). TEG offered real-time evaluation of coagulation dynamics, supporting transfusion strategies and aiding in the management of complex bleeding disorders across varied clinical contexts. Distinct and recurring graphical patterns—including the "shallot sign," "beetroot shoot," "trophy sign," and "pebbles on the street"—were observed. Overall, the study underscores TEG's utility as a point-of-care diagnostic tool in addressing diverse hemostatic challenges.

Keywords: Thromboelastography (TEG); Hemostasis; Point of care diagnostics; Coagulation profile; Clinical effectiveness

Abbreviations: aPTT: activated Partial Thromboplastin Time; CKH: Citrated Kaolin with Heparinase; CK: Citrated Kaolin; FFP: Fresh Frozen Plasma; INR: International Normalized Ratio; JAK2: Janus Kinase 2; MA: Maximum Amplitude; POCT: Point of Care Testing; PT: Prothrombin Time; R time: Reaction time; ROTEM: Rotational Thromboelastometry; TEG: Thromboelastography; HIPEC: Hyperthermic Intraperitoneal Chemotherapy

INTRODUCTION

Thromboelastography (TEG) is a technique for evaluating the effectiveness of whole blood coagulation. It gives a better picture in line with the cell-based model of hemostasis. Although it is increasingly used in emergency rooms, critical care units, perioperative wards and labour room, the effectiveness of this POCT is not appreciated by the medical community.

TEG as a point-of-care tool: It consistently provides faster, more dynamic information than conventional coagulation tests (PT, aPTT, INR, fibrinogen). Evidence underscores the role of TEG across diverse contexts, including trauma [1], cardiac bypass [2], and liver transplantation [3].

Correlation with conventional tests: Strong associations between fibrinogen levels and TEG alpha angle/maximum amplitute are seen in cardiac bypass and severe liver disease [2-4]. Platelet count correlates with Maximum Amplitude in postoperative samples. However, there is weak or inconsistent correlation with PT, INR, and APTT.

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Unique clinical scenarios

Trauma resuscitation: A 2018 plenary debate addressed fixed 1:1:1 transfusion versus TEG-guided individualized therapy. Dr. Lenworth Jacobs from University of Connecticut maintained that empirical 1:1:1 transfusion best approximates whole blood and ensures timely delivery of components, while Drs. Isaac Howley and Elliott Haut, Johns Hopkins University emphasized that Thromboelastography (TEG) enables precision resuscitation by identifying specific coagulation defects and tailoring therapy. The consensus was that fixed-ratio transfusion remains practical in emergent trauma care, but TEG-guided strategies show promise in reducing product use and improving survival [1].

Cardiac bypass surgery: In a North Indian study of 2018, postoperative TEG values (R-time and MA) predicted bleeding risk with fair accuracy, whereas routine coagulation tests failed to reliably identify patients at risk of postoperative blood loss [2].

Hemophilia A with heparinization: The case report from Tokyo, in the year 2020, described the use of TEG in a patient with hemophilia. The authors concluded that the reliability of TEG in estimating FVIII levels is limited under medium- to high-dose heparin, with ROTEM potentially offering greater accuracy in such settings [5].

Aim

In this case series we aim to:

Primary objective: To describe the clinical profile of patients for whom TEG was used at our Centre.

Secondary objective: To describe the various patterns of TEG reports.

CASE PRESENTATION

This was a retrospective collection of cases - Clinical history, indication for TEG and details of blood products given based on this report for all patient samples analysed with thromboelastography at our institute, between Jun 2022 to July 2023 were collected.

Sample analysis: Citrated kaolin assay was performed at the liver transplant OT on calibrated Biotem 4T Haemostasis Analyser (Figure 1).

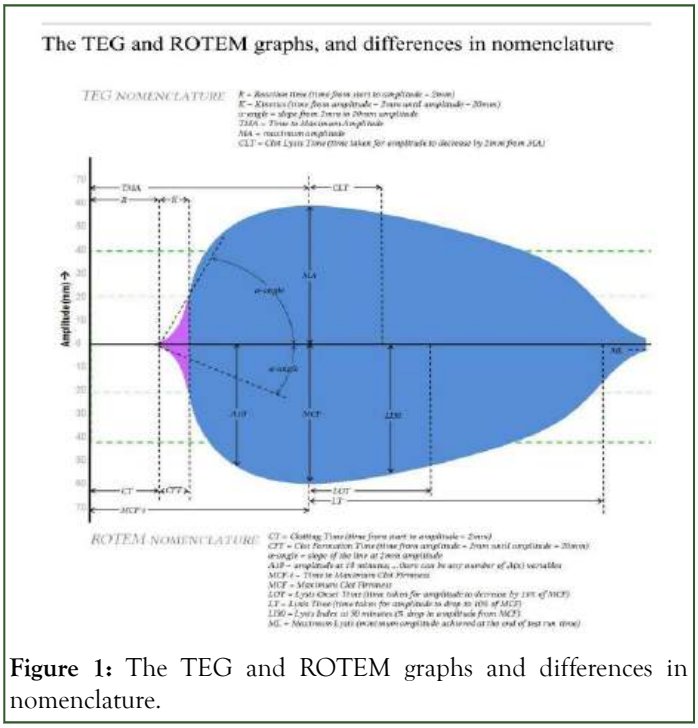

Figure 1: The TEG and ROTEM graphs and differences in nomenclature.

RESULTS

In this retrospective case series of about 61 patients (F: M=21: 40) serial TEG monitoring of their dynamic coagulation profile was done in 42% of cases.

The age of patients ranged from 7 months to 73 years. The most common indication was as a perioperative tool during live/deceased donor liver transplant for various indications (24.6%) followed by cytoreductive surgery with Hyperthermic Intraperitoneal Chemotherapy CRS – HIPEC (8.2%) (Figures 2 and 3).

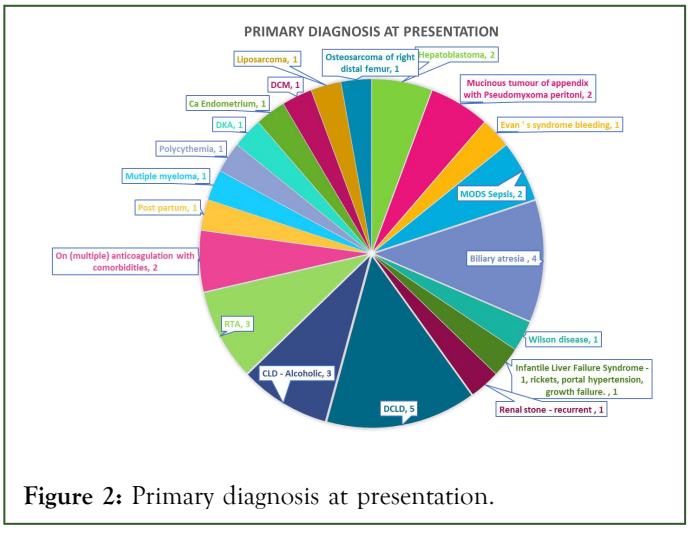

Figure 2: Primary diagnosis at presentation.

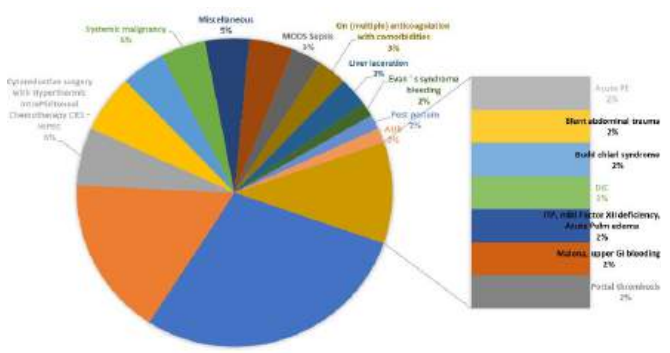

Figure 3: Indications for thromboelastography.

Interesting case 1: A 47 years old female, with history of multiple myeloma, post 4 cycles of VRD presented with mild epistaxis. She had MRSA positive sepsis. Conventional coagulation tests were normal. VHA guided transfusion of 2 PRBCs, 6 units of RDP and 10 units cryoprecipitate helped resolve her epistaxis (Figure 4).

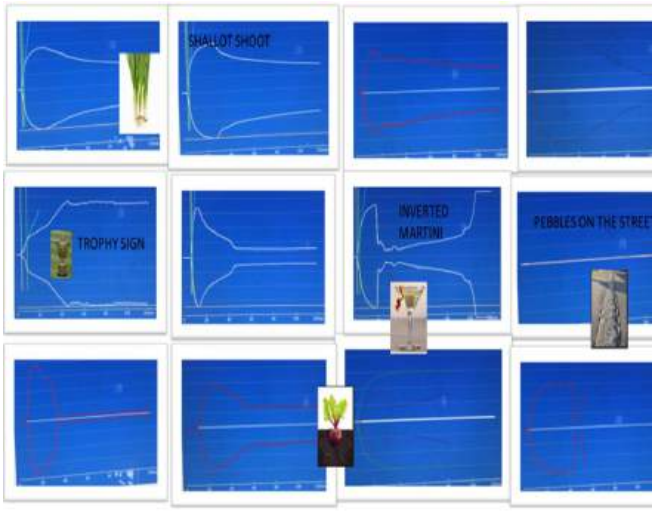

Figure 4: Representative signal waveform patterns named by visual analogy.

Interesting case 2: A 72-year-old female with JAK2 exon 14 mutation polycythemia was on aspirin and dalteparin. She presented with right upper limb compartment syndrome requiring right upper limb fasciotomy and evacuation of hematoma. Procedure was completed with minimal bleeding with the support of FFP based on TEG reports.

DISCUSSION

The role of TEG/ROTEM in liver transplantation [3,4], cardiopulmonary bypass [2] and trauma [6] is well established. In a tertiary care cancer hospital TEG is a 'ready reckoner' option for solutions to complex hemostatic problems like occurrence of malignancy, cytopenia(s), multi – organ involvement, and hence possibilities of multiple coagulation protein derangements.

The inverted martini, red wine glass and test tube are signs described in literature [7]. In our present study, we have noted the dynamic changes during the dissection, anhepatic and neo-hepatic phases of liver transplantation. We have noted few recurring patterns which we would like to describe as:

- "Shallot sign" – sharp change in pattern to fibrinolysis at Maximum Amplitude (MA).
- "Beetroot +/- shoot" – quick clotting followed by hyperfibrinolysis.
- Another pattern of interest was the "trophy sign" – slow onset of clotting followed by hypercoagulable state.
- "Pebbles on the street" – extremely hypo coagulable state.

Strengths: Some unique clinical scenarios where the TEG resolved the bleeding diathesis were noted.

Limitations of the study: The amount of blood products required during liver transplantation was less. However, because of the retrospective nature of the study we were able to only quantify each type of blood product.

Future direction: The dynamic changes of the graph during intraoperative Viscoelastic Hemostatic Assays (TEG/ROTEM) provide time points where new dynamics of hemostasis may be identified.

Technology evolution

- **TEG 5000 *vs.* TEG 6s:** The newer resonance technology and microfluidic cartridges-based TEG 6s offers automation, smaller sample volume, and reliable inter-device reproducibility. It can run up to four assays simultaneously without the need for reagent preparation, making it more efficient in clinical settings. TEG 5000 employs traditional cup and pin technology, requiring manual pipetting of samples and reagents. It allows for two assays to be performed simultaneously (Table 1) [8].
- **Platelet Mapping and TEG 6s assays:** Allow quantification of platelet function and antiplatelet drug effect [9,10].
- **ClotPro:** This is another viscoelastic platform with multiple assays for fibrinogen, anticoagulants, and fibrinolysis [11].

Table 1: Comparative summary of Thromboelastography (TEG) utility and limitations across diverse clinical settings.

Clinical setting	TEG utility	Limitations
Trauma resuscitation	Guides transfusion by identifying coagulopathy and fibrinolysis; enables individualized therapy vs fixed 1:1:1 ratios	Operator variability; limited universal reference ranges; retrospective data

Cardiac bypass surgery	Correlates with fibrinogen and platelet count; helps predict bleeding risk and transfusion needs	Weak correlation with PT/APTT; requires postoperative validation
Liver transplant/severe liver disease	Detects fibrinolysis and platelet dysfunction; correlates with fibrinogen and Maximum Amplitude	Conventional tests often discordant; lack of standardized cutoffs
Hemophilia A with heparinization	CK *vs.* CKH assays distinguish FVIII deficiency from heparin effect	Specialized assays needed; not widely available
Technology evolution (TEG 5000 *vs.* TEG 6s, Platelet Mapping™, ClotPro®)	Automation, reproducibility, platelet function assays; smaller sample volume; drug effect quantification.	Cost, accessibility, assay variability; lack of cross-platform standardization

CONCLUSION

- TEG excels at identifying fibrinolysis and platelet dysfunction, which conventional tests miss.
- **Interpretation requires context:** e.g., pregnancy reference ranges differ from non-pregnant, and heparin confounds FVIII assessment unless CKH is used.
- **Clinical impact:** TEG-guided transfusion often reduces blood product use and may improve survival (trauma, cardiac, liver surgery).
- **Limitations:** Operator variability, lack of universally accepted reference ranges, and retrospective designs in many studies.

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