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Case Series

Transfusion Medicine Section

Thromboelastography-guided Blood Product Management: A Series of Three Cases

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ABSTRACT

Thromboelastography (TEG) is a diagnostic tool used to assess blood clotting in real time by measuring the viscoelastic properties of blood. It measures the clot's strength and stability. It provides a comprehensive view of haemostasis, which includes clot formation, strength, and dissolution. This can be useful in clinical settings by guiding transfusion and anticoagulation therapy in various medical conditions. It can be useful in blood product administration for the patient's specific needs. TEG can help assess the functional capacity of the liver in relation to clotting factor production and the overall coagulation process. In obstetric patients, particularly during labour and complications during delivery, TEG can help manage and predict bleeding risks associated with conditions like preeclampsia or Disseminated Intravascular Coagulation (DIC). Here, we discussed three separate cases (1 male, 2 females) described, each presenting unique clinical scenarios, including those from Intensive Care Unit (ICU) settings. A case of Postpartum Haemorrhage (PPH) with Hemolysis, Elevated Liver enzymes, and Low Platelets (HELLP) syndrome, a case of haemophilia A, and a case of snake bite with signs of envenomation were managed with TEG to guide component-based therapy, based on the specific needs of each patient.

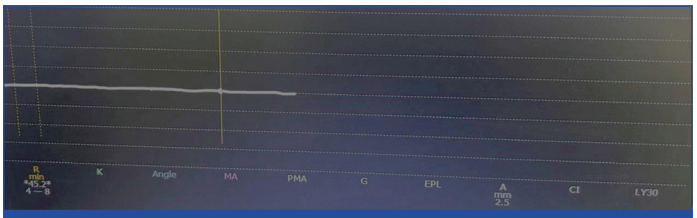
Keywords: Coagulopathy, Haemostasis, HELLP syndrome, Postpartum haemorrhage

INTRODUCTION

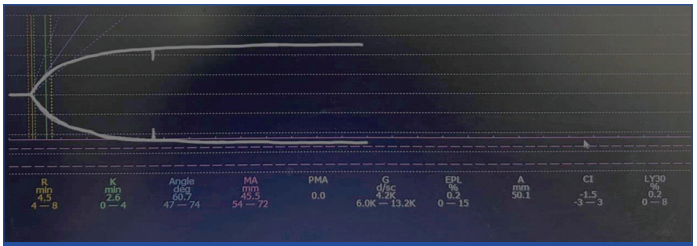
The TEG is a global test for blood coagulation. It measures the viscoelastic properties of whole blood clot formation. Traditional coagulation tests like platelet count, activated Partial Thromboplastin Time (aPTT), Prothrombin Time (PT), International Normalised Ratio (INR), Activated Clotting Time (ACT), and plasma fibrinogen levels are indeed valuable tools for assessing baseline coagulation status and diagnosing specific coagulation disorders [1,2]. However, they do have limitations when it comes to managing dynamically changing coagulation conditions. TEG assesses the whole component of clot formation, clot kinetics, clot stability, and clot resolution [3,4]. It helps to evaluate the quick need for specific blood product transfusion in severely bleeding patients in the Emergency Room (ER) and ICU [5]. TEG is helpful in the management of severely bleeding surgery, trauma and critically ill patients. TEG is helpful in the management of massive bleeding during surgical, trauma and critically ill patients [6]. TEG, introduced in 1948 by Helmut Hartert at the University of Heidelberg, has been in use for over 60 years [7]. The first clinical use of TEG was used in the Vietnam War. It played a crucial role in facilitating blood transfusion for injured soldiers [8]. Nowadays, TEG is primarily used in liver transplants and Cardiovascular Surgery (CTVS).

Case 1

A 38-year-old female presented with the chief complaint of a snake bite that occurred on 3rd September 2023 at approximately 7:45 PM. Bite marks were present on her right foot. The patient had nausea, vomiting, headache and had been treated elsewhere with eight vials of Antisnake Venom (ASV) and an injection of neostigmine. Initial investigations were performed at an outside facility, then the patient came to the respected hospital. She underwent routine investigation on Haemoglogin (Hb)-10.3 gm/dL, Total leukocyte count-22290 cells/cumm^3, Platelet count-3.16 lac/cumm^3 and INR-1.64. The patient was intubated at approximately 8:30 PM at the previous hospital, but became agitated and was subsequently re-extubated. She had developed altered sensorium and was then shifted to the present hospital for further management. In the ER, the patient was intubated in view of low Glasgow Coma Scale (GCS) and started on inotropic support. Post-intubation, patient had bloody secretions from the tube. The Whole Blood Clotting Test (WBCT) was repeated every six hourly and ASV was administered accordingly to the patient's weight. Totally, 30 vials of ASV were given. TEG was requested. The TEG report [Table/Fig-1] showed no tracing, R Time was prolonged, hence advised transfusion of eight units of Fresh Frozen Plasma (FFP), four units of cryoprecipitate according to patient weight. After transfusion, TEG showed a corrected R time and alpha angle [Table/Fig-2], which meant the patient was improving. The patient was extubated, and inotropic support was gradually tapered and discontinued. Patient was treated with antibiotics for mild cellulitis during their hospital stay.



[Table/Fig-1]: Initial TEG tracing of snake bite patient.

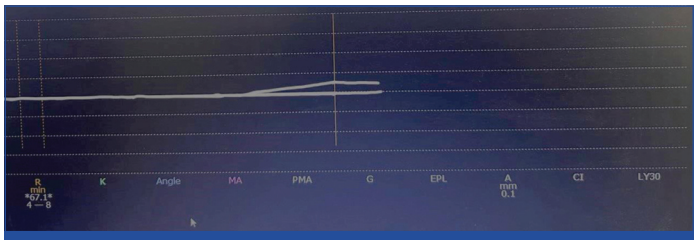


[Table/Fig-2]: TEG after transfusion of FFP and cryoprecipitate in a case of snake bite.

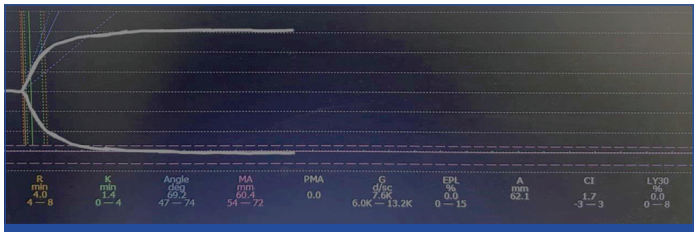
The patient showed symptomatic improvement after receiving antibiotic therapy for mild cellulitis. The patient was closely monitored, and as the infection responded positively to treatment. After recovery patient was discharged with instructions to complete the prescribed course of oral antibiotics review for after 15 days.

Case 2

A 30-year-old female (P1L1D1) presented on Postoperative Day 2 (POD 2) following an emergency caesarean section performed elsewhere due to Intrauterine Foetal Demise (IUFD) of twin one at 31 weeks and five days of gestation. Five days prior, she was apparently normal but then developed vomiting and epigastric pain, which led to her admission. She had a history of severe anaemia (haemoglobin 6.9 g/dL) and complained of decreased foetal movements. Ultrasonography performed elsewhere confirmed the IUD of twin 1. During the emergency Lower Segment Caesarean Section (LSCS) procedure, PPH was noted, and the patient received one unit of packed red blood cells and two units of fresh frozen plasma. After the surgery, she developed yellowish discoloration of the skin, high-coloured urine, fever, and chills. Her liver function test was elevated hence was referred to present hospital. Patient was admitted to the ICU with above mentioned complaints. All baseline investigations were done and showed Hb-6.1 g/dL, Total leukocyte count-30290 cells/cumm^3, platelet count-one lac/cumm^3. Liver function test showed elevated total bilirubin-7.46 mg/dL and deranged liver enzymes, serum lipase-2110 units/litre, serum amylase-467 units/litre, lipid profile was normal. Serum fibrinogen-26.7 mg/dL, PT-26.9 seconds, PTT-43.7 seconds, INR-2.4. TEG was ordered [Table/Fig-3]. The TEG results indicated prolonged R Time and K Time, along with a reduced Alpha angle. Based on these findings, twelve units of fresh frozen plasma and four units of cryoprecipitate were transfused. The subsequent TEG reports [Table/Fig-4] and coagulation profile showed normal results following the transfusion. Liver enzymes were elevated, and a medical gastroenterology opinion was obtained which led to the diagnosis of postpartum HELLP syndrome with coagulopathy and acute pancreatitis. Due to severe anaemia, the patient was transfused with one unit of packed red blood cells. A haematology opinion was obtained for persistent anaemia with thrombocytopenia. The haematologist suggested estimating serum haptoglobin, which returned normal results. Furthermore, as advised, a bone marrow aspiration revealed hypocellular marrow. Patient developed one episode of generalised tonic clonic seizure, for which Magnetic Resonance Imaging (MRI) brain with venogram was done, showed features of atypical posterior reversible encephalopathy syndrome and normal venogram. Patient was started on antiepileptics and magnesium sulfate. Patient's condition improved subsequently and was discharged after 15 days of hospital admission.



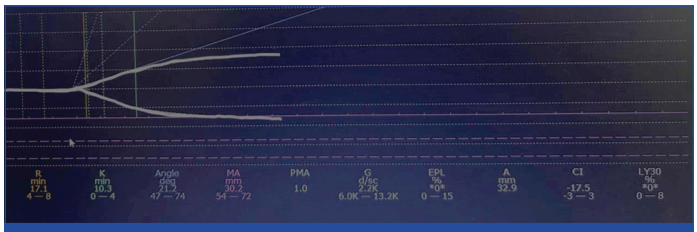
[Table/Fig-3]: Initial TEG in a case of PPH.



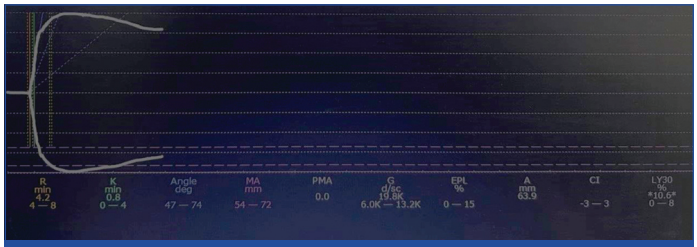
[Table/Fig-4]: TEG after transfusion in a case of PPH.

Case 3

A 26-year-old male presented with complaints of abdominal pain over the left hip for the past two days, along with a history of two episodes of syncope. At the time of admission, his vital signs were as follows: a pulse rate of 165 beats per minute (tachycardia), blood pressure of 90/60 mmHg, and a respiratory rate of 20 breaths per minute. On systemic examination, the abdomen was soft, but guard was present. The Electrocardiogram (ECG) showed sinus tachycardia. Investigation at the time of admission: Hb-6.22 gms/dL, Total leukocyte count-31600 cells/cumm^3, platelet count-4.5 lacs/cumm^3, liver function test and renal function test reports were normal. Ultrasonography showed left internal iliac haemorrhage, haemoperitoneum, large left spontaneous retroperitoneal hematoma (volume around 650 cc). Past history revealed bleeding tendency in childhood particularly after fall. Two years ago, he developed swelling in his left forearm and experienced easy bruising. He had not received any treatment and was not dependent on transfusions. Complete coagulation work-up showed prolonged PT-14.9, aPTT-72.7 seconds, INR-1.20 and baseline level of Factor VIII deficiency 4% (Biological reference range 70-150%) moderate Haemophilia A. The case was referred to haematology, where the patient was diagnosed with moderate Haemophilia A, and a plan for recombinant factor 8 was made. TEG was ordered for further evaluation. TEG [Table/Fig-5] showed prolonged R time and K time, along with a reduced alpha angle. These findings indicated diffuse coagulopathy, with a reaction time (R) of 42.2 minutes, a clot formation time (K) of 9.8 minutes, an alpha angle of 22 degrees, and a Maximum Amplitude (MA) of 53.9 mm. Eight units of fresh frozen plasma and eight units of Cryoprecipitate were transfused. After transfusion TEG [Table/Fig-6] was normal. According to the patient's weight, the patient started on Inj. Recombinant Factor VIII (3000 units i.v. every 12 hours for 2 days). The rechecked factor VIII level increased to 74%. The patient was treated with i.v. antibiotics and Inj. Trapic. The patient was stable, with no further complaints, and was discharged with the appropriate medication and review after 15 days. The patient failed to return for scheduled follow-up appointments.



[Table/Fig-5]: TEG in a case of moderate Haemophilia A.



[Table/Fig-6]: Post-transfusion TEG in a case of Haemophilia A.

DISCUSSION

The TEG parameters are important in assessing different aspects of clot formation and fibrinolysis. TEG tests are most commonly performed as point of care or near real time test [8,9]. However, this testing method is used to guide transfusion strategies in specialty areas including trauma, obstetrics, liver transplantation and haemophilia [10]. The TEG parameters collectively provide a comprehensive assessment of the coagulation process, from initial fibrin formation to clot strength and stability, and the potential for fibrinolysis. They are valuable in guiding clinical decisions related to managing bleeding or thrombotic disorders, monitoring anticoagulant therapy, and assessing overall haemostatic function and to guide blood component therapy [11].

The study by Vendhan R et al., demonstrated promising results in ICU patients, particularly in predicting or improving outcomes related to sepsis, coagulopathy, thrombotic events, ICU duration,

hospital stay, and ventilator duration [1]. A study by Khanna P et al., concluded that point-of-care viscoelastic assays are more effective than conventional transfusion strategies in primary PPH. TEG assays will be helpful in facilitating quick decision-making, reduce unnecessary transfusions, and help prevent complications Transfusion-Associated Circulatory Overload (TACO). The authors stress the need for larger RCTs to validate the efficacy and cost-effectiveness of viscoelastic testing for bleeding management in obstetric haemorrhage [12]. A study by Sato K et al., studied TEG for coagulation assessment in a haemophilia A patient undergoing Endovascular Aneurysm Repair (EVAR). They found that TEG with heparinase couldn't fully eliminate heparin's effect or accurately reflect FVIII levels [13]. The study by Rodgers SC et al., identified the significant sex-based variation in TEG parameters. Specifically, females exhibited shorter K times, steeper alpha angles, and higher MA values compared to males. Multivariate analysis further indicated that sex, rather than age or race, was the primary factor explaining the differences in TEG parameters [14]. While TEG offers better insights than routine tests like PT, aPTT combining viscoelastic monitors with routine tests could improve coagulation management in haemophilia patients needing heparinisation during surgery.

HELLP syndrome is a critical condition during and after childbirth, requiring a multidisciplinary approach to manage coagulopathy, liver dysfunction, and haematological abnormalities. TEG plays a key role in assessing and managing coagulopathy, providing real-time guidance for transfusion decisions. PPH is the leading cause of maternal morbidity and mortality. Management of severe PPH involves the administration of packed red blood cells and fresh-frozen plasma, along with uterotonic medications and surgical interventions. Conventional coagulation tests take 45 to 60 minutes to return results. TEG is a point-of-care test that assesses coagulation status more rapidly [15]. TEG guided blood product management is useful for directing appropriate treatment support in patients.

CONCLUSION(S)

The TEG facilitates timely and accurate decisions regarding the need for specific blood products in emergency and intensive care settings. However, further research is essential to determine the optimal transfusion triggers, assess long-term outcomes, and cost-effectiveness. Ongoing research and clinical case studies support the efficacy of these methods in improving patient outcomes during surgery. Future studies should focus on standardising protocols for point-of-care testing in the management of blood products in ICU and operation theatre settings.

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