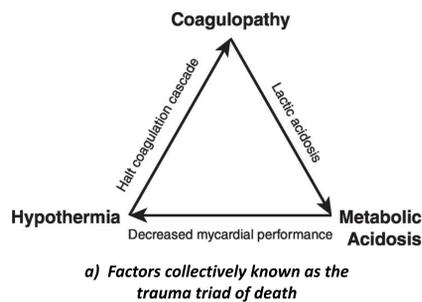


Can Viscoelastic Assays Reduce the Amount of Blood Products Used in Hemorrhaging Trauma Patients?

Julie Hartney, BSN, CCRN, TCRN, AG-ACCNS Student
Loyola University of Chicago Marcella Niehoff School of Nursing

Background

- Traumatic injuries are a leading cause of significant morbidity and mortality across age groups in the U.S., with death occurring due to exsanguination in over 40% of patients (loss of both volume and clotting factors)
- Trauma induced coagulopathy (TIC) composed of three major factors:
 - Consumption and depletion of native clotting factors
 - Increased fibrinogen breakdown
 - Platelet dysfunction
- Coagulopathy can be further worsened by acidosis and hypothermia



- Increasing push across all areas of care to provide more individualized care to patients
- Achieving hemostasis in trauma is taking on an increasingly multi-faceted approach, using multiple operative and non-operative interventions and assessments including:
 - Damage control surgery
 - Permissive hypotension
 - Fixed ratio massive transfusion (MTP) at 1:1:1 ratio so as to mimic the composition of whole blood
 - Viscoelastic assays (TEG, RoTEM)
 - Pharmacologic agents to intervene in clotting cascades (TXA, fibrinogen concentrates, etc)
- Viscoelastic assays have been in place since the 1940s and are well studied in the cardiac surgery and liver transplant populations
 - Thromboelastography (TEG) or Rotational Thromboelastometry (RoTEM) both provide similar illustrations and information on how a patient able a patient is to form, maintain, and eventually lyse clots, as well as any derangement in these activities
 - Both tests provide the same information on clotting information but differ slightly based on reagents used and machine structure (TEG cup oscillation vs. RoTEM pin oscillation)

Purpose

The purpose of this review was to identify the impact of viscoelastic assays on transfusion practices in hemorrhaging trauma patients, looking specifically at:

- Reduction in the total numbers of blood products (FFP, PRBCs, platelets) administered
- Differences in amounts of blood products administered when massive transfusion was guided by fixed ratio (1:1:1) versus viscoelastic assay

Method

- PubMed was reviewed for appropriate articles using the search terms “thromboelastography” and “blood product”
- 6 studies were found to investigate the impact of viscoelastic assays on blood product utilization while massively transfusing the hemorrhaging trauma patient
- 2 randomized control trials were identified, one exclusively investigating the impact of TEG and the other investigating a mix of TEG and RoTEM cases
- The remaining 4 studies were retrospective in nature
 - 3 of which looked at the impact of TEG on blood transfusion practices in hemorrhaging trauma patients
 - 1 investigated the impact of RoTEM on blood transfusion practices when used in combination with prophylactic administration of tranexamic acid

Results

Retrospective studies

- Use of TEG or RoTEM promotes a change in transfusion strategy from blindly following 1:1:1 ratio to specifically correcting coagulopathies, which ultimately will help control hemorrhage and blood loss
- Differences in transfusion requirements identified between mechanisms of injury (blunt vs. penetrating)
- Tranexamic acid use variable in these studies, not empirically administered as much in the US; fibrinogen concentrate use also variable
- Statistically significant reductions in mortality noted in 3 of 4 studies with the use of viscoelastic assays and a reduction in mortality (though unclear if this is due to improved blood product utilization or a myriad of other factors) (Tapia)

- Reductions in length of stay noted when TEG used (9-11 days in one study!)

Randomized Control Trials

- Gonzalez et al. (2016) — single center, TEG only
 - Findings from this study included increased ventilator free days and reduced days spent in the ICU, as well as significantly reduced mortality when TEG was used ($p=0.011$ for overall mortality, $p=0.020$ for hemorrhagic deaths)
 - There was a reduced number of PRBCs transfused, though no significant differences in total number of components used.
 - The use of TEG in these patients was thought to improve the strategy of transfusion in these patients, gearing more towards correcting the trauma induced coagulopathy than just issues of volume
 - No clear differences in administration of tranexamic acid were noted

- Baksaas-Aasen et al. (2021) - multi center, TEG and RoTEM
 - Empiric dosing of tranexamic noted (377-396 patients receiving TXA)
 - Mortality somewhat reduced (not statistically significant), though blood product volumes and adverse events equal between groups
 - Not all patients benefit from hemostatic interventions and more research is required to understand who truly benefits

Implications for Research and Practice

Research and Practice Implications

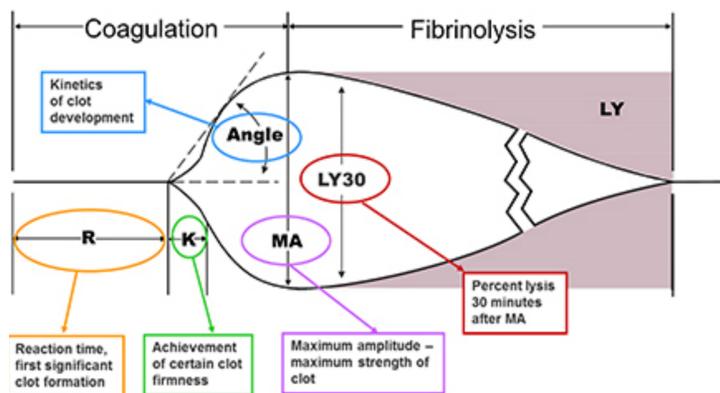
- Unable to make definitive conclusions regarding the relationship between viscoelastic assays and their impact on the amount of blood products used in the care of hemorrhaging trauma patients.
 - Varying conclusions among the studies
 - Lower levels of evidence
 - Difficulty differentiating results caused by viscoelastic assays alone when agents like tranexamic acid or fibrinogen concentrates are used
- Viscoelastic assays reduced hospital stay in some studies. How are other key metrics (ARDS, VTE, sepsis) impacted by the use of viscoelastic assay guided massive transfusion?
- From a practical aspect, unclear how often the information viscoelastic assays is being used to guide massive transfusion due to logistical constraints (ex delays in obtaining samples, delays in running tests or uploading information)
- Questions remain whether there are significant differences in transfusion requirements and management between mechanisms of injury (blunt vs. penetrating). Could viscoelastic assays help identify subtle differences in management? Further research is needed!

Nursing Implications

- Blood is often a scarce resource but has become an increasingly critical resource due to shortages created by COVID and over-transfusion of blood has been shown to worsen rates of ARDS and sepsis
- Staff nurses are keenly aware of blood supplies, especially in areas with easily available stock (ED, OR, procedural areas)
- Staff nurses are typically in charge of pattern in which blood products are transfused and often times the rate at which products are transfused
- Nursing knowledge of this test, results, and available interventions will be helpful to make recommendations that are individualized to each patient
- For advanced practice nurses, use and ability to interpret viscoelastic assay results can be very helpful in distinguishing patients who are exclusively coagulopathic from those who may require intervention (especially in post-operative settings)

Conclusion

- Viscoelastic assays (TEG, RoTEM) can be helpful in providing more detailed information regarding the trauma patient’s ability to form, maintain, and lyse clots, particularly in cases of significant hemorrhage and coagulopathy
- More research (particularly higher level evidence) is required to understand the full impact of this test on this patient population, particularly in regards to its impact on transfusion practices (in isolation or combination with fibrinogen concentrates, TXA, or other adjuncts)
- More research is needed to understand how viscoelastic assays are actually being used and interpreted for the care of hemorrhaging trauma patients



b) A view into a viscoelastic assay diagram and the values recorded

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