Blood Management and Protocol Use in Active Bleeding

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Acknowledgements

• Stephanie Barringer (Manager, UHE Blood Bank/Laboratory)
• Dr. Scott Scrape (OSU Hematology, Medical Director, Blood Bank)
• Dr. Antolin Flores (OSU CV Anesthesiology)
No Disclosures

Objectives

• The participant will understand the concept of patient blood management and why it is important to both patients and providers.
• The participant will have an improved understanding of the impact blood transfusion therapy has on both patients and the hospital.
• The participant will gain an understanding of the practicality of protocol use for routine and emergency blood management scenarios.
• The participant will understand the rationale behind mass transfusion protocol development and its use in different hospital settings.
Discussion Outline

- Blood management? What and why?
- Evidence for conservative transfusion management?
- Adjuncts/Alternatives to transfusion
- The Mass Transfusion Protocol (MTP)
- MTP readiness in your hospital

Blood products in the US....

- Every two seconds someone in the U.S. needs blood.
- Approximately 36,000 units of red blood cells are needed every day in the U.S.
- Nearly 7,000 units of platelets and 10,000 units of plasma are needed daily in the U.S.
- Nearly 21 million blood components are transfused each year in the U.S.

Patient Blood Management: What?

- Patient blood management (PBM) is an evidence-based, multidisciplinary approach to optimizing the care of patients who might need transfusion.

American Association of Blood Banks
**Patient Blood Management (PBM)**

- **Multi-disciplinary approach**

**Blood product availability** → **Mass transfusion Scenario** → **Damage Control** → **Transfusion** → **Guidelines**

- **Anemia**
- **Pharmacologic management**

**Blood Management**

- Broader perspective than transfusion alone
- Earlier treatment of coagulopathy
- Vigilant monitoring
- Communication
Broader perspective than transfusion

<table>
<thead>
<tr>
<th>Preoperative</th>
<th>Optimise erythropoiesis</th>
<th>Minimise blood loss</th>
<th>Manage anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identify, assess, and treat anaemia</td>
<td>• Identify and manage bleeding risk (past and family history)</td>
<td>• Compare estimated blood loss with patient-specific tolerable blood loss</td>
<td></td>
</tr>
<tr>
<td>• Consider preoperative autologous blood donation</td>
<td>• Review medications (antiplatelet, anticoagulation treatment)</td>
<td>• Assess and optimise patient’s physiological reserve (e.g., pulmonary and cardiac function)</td>
<td></td>
</tr>
<tr>
<td>• Consider erythropoiesis-stimulating agents if nutritional anaemia is ruled out or treated</td>
<td>• Minimise iatrogenic blood loss</td>
<td>• Formulate patient-specific management plan with appropriate blood conservation modalities</td>
<td></td>
</tr>
<tr>
<td>• Refer for further assessment if necessary</td>
<td>• Procedure planning and rehearsal</td>
<td>to manage anaemia</td>
<td></td>
</tr>
<tr>
<td>• Unmanaged anaemia (haemoglobin in women &lt;120 g/L, haemoglobin in men &lt;130 g/L) is a contraindication for elective surgery</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Intraoperative</th>
<th>Time surgery with optimisation of red blood cell mass</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>• Meticulous haemostasis and surgical techniques</td>
<td>• Optimise cardiac output</td>
<td>• Maximise oxygen delivery</td>
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<tr>
<td>• Blood-sparing surgical techniques</td>
<td>• Optimise ventilation and oxygenation</td>
<td>• Minimise oxygen consumption</td>
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<tr>
<td>• Anaesthetic blood-conservation strategies</td>
<td>• Evidence-based transfusion strategies</td>
<td>• Avoid and treat infections promptly</td>
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<tr>
<td>• Acute normovolaemic haemodilution</td>
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<td>• Evidence-based transfusion strategies</td>
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<tr>
<td>• Cell salvage and reinfusion</td>
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<tr>
<td>• Pharmacological and haemostatic agents</td>
<td></td>
<td></td>
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<tr>
<td>• Avoid coagulopathy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Postoperative</th>
<th></th>
<th>Manage anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Manage nutritional or correctable anaemia (e.g., avoid folate deficiency, iron-restricted erythropoiesis)</td>
<td>• Monitor and manage bleeding</td>
<td>• Maximise oxygen delivery</td>
</tr>
<tr>
<td>• Treatment with erythropoiesis-stimulating agents if appropriate</td>
<td>• Maintain normothermia (unless hypothermia indicated)</td>
<td>• Minimise oxygen consumption</td>
</tr>
<tr>
<td>• Be aware of drug interactions that can cause anaemia (e.g., ACE inhibitor)</td>
<td>• Autologous blood salvage</td>
<td>• Avoid and treat infections promptly</td>
</tr>
<tr>
<td></td>
<td>• Minimise iatrogenic blood loss</td>
<td>• Evidence-based transfusion strategies</td>
</tr>
<tr>
<td></td>
<td>• Management of haemostasis and anticoagulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Awareness of adverse effects of medications (e.g., acquired vitamin K deficiency)</td>
<td></td>
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</tbody>
</table>

Spahn DR. Alternatives to blood transfusion. Lancet, 2013; 381:1855-65
### Early management of coagulopathy

- Mass transfusion
PATIENT SAFETY SERIES

Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety

Laurence E. Shields, MD; Suzanne Wiesner, RN; Janet Fulton, RN, PhD; Barbara Pelletreau, RN

Am J Obstet Gynecol 2011;205(4):368e1-8

2 year observational study, large community health system

Substantial reduction in transfusion rate
(16.7 to 6.3/month, p<0.01)

Reduced coagulopathy in PPH patients
(DIC reduced by 64%, p<0.01)

Patient Monitoring

• Clinical suspicion
• Physiologic parameters (ex. Ca\textsubscript{i}, acid/base balance, temperature)
• Lab based / Point-of-care testing
• Transfusion thresholds (?)
Communication

Patient Blood Management: Why?
Contributing to patient safety...
ACS-NSQIP (American College of Surgeons – National Surgical Quality Improvement Program) data

- Increased risk of 30 day morbidity and mortality in general surgery patient receiving 1 unit of PRBCs
- Transfusion of 2 intraoperative units further increased risk of surgical site infection in these patients

**Transfusion: Risk vs Benefit**

<table>
<thead>
<tr>
<th>Risks</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>TRALI (#1 mortality)</td>
<td>Improved O2 carrying capacity</td>
</tr>
<tr>
<td>TACO (#2 mortality)</td>
<td>Improved coagulation</td>
</tr>
<tr>
<td>Infection</td>
<td>Hemodynamic stability</td>
</tr>
<tr>
<td>Immunomodulation</td>
<td></td>
</tr>
<tr>
<td>Transfusion rxns</td>
<td></td>
</tr>
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</table>

Fatalities reported to the FDA: Annual summary for fiscal year 2014. fda.gov
Efficiency of product delivery...

• Emergency and mass transfusion protocol development

Massive Transfusion Protocols: The Role of Aggressive Resuscitation Versus Product Ratio in Mortality Reduction

Daniel J Riskin, MD, MBA, Thomas C’Tsai, BS, Loren Riskin, MD, Tina Hernandez-Boussard, PhD, MPH, Maryanne Purtill, MD, Paul M Maggio, MD, MBA, FACS, David A Spain, MD, FACS, Susan I Brundage, MD, MPH, FACS

*J Am Coll Surg 2009; 209:198-205*

Level 1 trauma center, introduced MTP, 4 year review

Mortality deceased with implementation of a MTP without change in transfusion ratio

“Our data underscore the importance of expeditious product availability…”
A continued need for waste reduction in blood management?

Appropriateness of Allogeneic Red Blood Cell Transfusion: The International Consensus Conference on Transfusion Outcomes
Shander A., et al.


- International multi-disciplinary panel
- 450 stable inpatient scenarios
- 11% RBC transfusion considered appropriate
- 29% uncertain

59% Inappropriate
One unit... or two?


Opportunity for cost savings?
What do products cost?

• At our institution,
  
  – RBC base unit, $215
  – Plasma (FFP), $42
  – Platelets, $600-800
  – Cryoprecipitate, $750-800

Activity-based costs of blood transfusions in surgical patients at four hospitals

Aryeh Shander, Axel Hofmann, Sherri Ozawa, Oliver M. Theisinger, Hans Gomboz, and Donat R. Spahn from the Society for the Advancement of Blood Management (SABM) and the Medical Society for Blood Management (MSBM)

Transfusion 2010;50:753-765

RBC purchase cost represented only 21-28% of total transfusion cost (range $726 to $11,835 / unit)

Annual transfusion cost between $1.6 and $6 million per hospital largely dependent on transfusion rate
For safety and savings, lab takes on transfusions

Ann Griswold, PhD

July 2014—Hospitals are under fire to cut costs, and more often than not that means layoffs, forgoing new equipment, and watching from the sidelines as the medical literature touts advances that could help patients now—if only institutions could afford to implement them.

“Implementation of a new blood use initiative…”

“Health First saved $1.44 million dollars by changing transfusion practices to conform to national guidelines”

Patient Blood Management: Why?

Improve patient safety, outcomes, and process efficiency while reducing waste and care-related cost
Is there evidence to support a conservative approach in PBM?

- Generally, yes…

- Evidence over the past 20 years supports a more conservative approach to transfusion practice in most patient populations

- Outcomes using a conservative strategy no worse than liberal strategy in most cases

- Reduced blood product administration
Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion


Transfusion Requirements After Cardiac Surgery: The TRACS Randomized Controlled Trial


Transfusion Strategies for Acute Upper Gastrointestinal Bleeding


Liberal or Restrictive Transfusion in High-Risk Patients after Hip Surgery


A Multicenter, Randomized, Controlled Clinical Trial of Transfusion Requirements in Critical Care


- American Association of Blood Banks
- American Society of Anesthesiologists
- American Society of Hematology
- Society of Critical Care Medicine
- Society of Hospital Medicine
In general:

- Restrictive trigger for RBC transfusion typically defined as a Hgb < 7-8 g/dl (or Hct < 25%)

- In the actively bleeding / symptomatic patient, there is no arbitrary threshold

- The decision to transfuse is a medical decision that must be individualized to each patient


“Thinking” conservatively...

Ensure that patients who need blood get every drop they need, and not a drop more
Transfusion Therapy: Indications for Ordering
The Ohio State University Wexner Medical Center

- These practice guidelines have been developed by a cross-functional group of physicians, management, and staff to advance the safety and quality of care for patients receiving blood transfusions.
- When applying these guidelines, practitioners must use their training, experience, judgment, and a patient’s specific clinical information to make optimal decisions on the patient’s behalf.
- These guidelines cannot substitute for clinical judgment or the need for flexibility in practice and should not be considered a mandate to transfuse or not to transfuse.

Multi-disciplinary transfusion committee developed evidence-based hospital guideline for transfusion therapy

Flexibility to allow for important clinical decision-making based on situation

Red Blood Cells

- **Active Bleeding**
  - Hemorrhagic shock
  - No Hgb threshold
  - MTP

- **Bleeding Risk**
  - Non-life threat, Hgb<8
  - If expect large, life threat intraop bleeding and Hgb<10
  - If expect small, non-life threat intraop bleeding, and Hgb<8

- **Anemia**
  - Asymptomatic
  - Symptomatic
  - Hgb<7
  - Hgb<8 with CV disease

Transfusion Therapy: Indications for Ordering -
The Ohio State University Wexner Medical Center
Plasma and Platelets

- Historically suggested thresholds typically used to guide therapy
- No real evidence basis
- Standard lab based testing used to establish baseline if given time

| Plasma |
|---|---|
| **Active Bleeding** | **Bleeding Risk** |
| INR ≥ 1.5 | MTP |
| *Hemorrhage with PTT > 60s | FBG < 100 mg/dl |
| Hemorrhage with severe liver disease | Hemorrhage with DIC or Vitamin K depletion |

*excluding heparin or lupus anticoagulant effect

Transfusion Therapy: Indications for Ordering -
The Ohio State University Wexner Medical Center
## Platelets

<table>
<thead>
<tr>
<th>Acute mass hemorrhage, Neurosurgery, LVAD</th>
<th>Chronic stable thrombocytopenia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Count &lt;100,000/μL</strong></td>
<td><strong>Count &lt;5,000/μL</strong></td>
</tr>
<tr>
<td><strong>Count &lt;50,000/μL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Count &lt;20,000/μL</strong></td>
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</tbody>
</table>

DIC, hemorrhage, LP, major surgery

Sepsis, or other hemostatic d/o
Brain tumor, bone marrow bx

BMT, Acute leukemia, solid tumors

**Count <10,000/μL**

DIC, hemorrhage, LP, major surgery

**Count <10,000/μL**

**Count <20,000/μL**

Platelet function d/o > 100,000/μL

Transfusion Therapy: Indications for Ordering - The Ohio State University Wexner Medical Center

**Streamlining the process for standard transfusion:** examples of protocol use
# Obtaining Blood Products Checklist

**Standard Transfusion OR/ED**

*For any issues or concerns, please contact the Attending Apheresis Pathologist from the "Pathology/Clinical Lab" on call schedule search on WebXchange*

- **Order**
  - Physician order placed to include the number of units requested (multiple units can be requested)

- **Blood Product Release White Paper Slip:**
  - Must be taken/sent to lab in order to for Blood Bank to release blood product
  - Slip should include the following:
    - Patient label
    - Amount and name of blood product to be immediately released (up to 2 units of PRBC’s or (2) FFP’s will be released at one time).

- **Blood Transport Cooler**
  - For 2 units, the Blood Bank will release blood products in a cooler.
  - Blood products should remain in the cooler until transfused or returned to lab
  - All unused product must be sent back to lab within 3.5 hours
  - The Cooler must remain closed unless retrieving blood products
  - Cool gel packs and a reminder timer will accompany the cooler

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**Adjuncts / Alternatives to standard product transfusion?**
### Adjuncts/Alternatives to standard product transfusion...

- Crystalloids (isotonic saline, lactated ringers)
- Colloids (albumin, hetastarch, hypertonic saline-dextran)
- Red cell recovery (cell-saver) ✓
- Autologous donation X
- Epoetin alfa $

---

### Adjuncts/Alternatives to standard product transfusion...

- Vitamin K
- Factor concentrates (ex. PCC, fibrinogen) $
- Anti-fibrinolytics (ex. Transexamic acid) ✓
Mass Transfusion Protocols

Consider...

23 y/o male GSW to chest

Responsive, HR 125, BP 88/40
Patient Blood Management (PBM)

- Multi-disciplinary approach
- Blood Bank
- Lab
- Nursing
- Hematology
- Surgery
- Anesthesia
- Medicine
- Critical Care

Blood product availability

Mass transfusion Scenario

Damage Control

Mass Transfusion Protocols (MTP)

Transfusion

Pharmacologic management

Mass Transfusion Protocols

- No generally excepted format
- Streamline efficient delivery of life-saving products when needed
- Facilitate identification of decision points in mass bleeding situation
- Standardize optimization of patient care
Mass Transfusion Protocols

- Should be developed by multi-disciplinary committee
- Should address triggers for initiation
- Products available for immediate transfusion
- Continued management during patient transfers (ex. ER → OR)
- Use of adjunct agents
- Termination

### Massive transfusion protocol (MTP) template

The information below, developed by consensus, broadly covers areas that should be included in a local MTP. This template can be used to develop an MTP to meet the needs of the local institution’s patient population and resources.

**Senior clinician** determines that patient meets criteria for MTP activation

#### Baseline:
- Full blood count, coagulation screen (PT, INR, APTT, fibrinogen), biochemistry, arterial blood gases

Notify transfusion laboratory (insert contact no.) to: ‘Activate MTP’

**Laboratory staff**
- Notify haematologist/transfusion specialist
- Prepare and issue blood components as requested
- Anticipate repeat testing and blood component requirements
- Minimise test turnaround times
- Consider staff resources

**Haematologist/transfusion specialist**
- Liaise regularly with laboratory and clinical teams
- Assist in interpretation of results, and advise on blood component support

**Senior clinician**
- **Request:**
  - 4 units RBC
  - 2 units FFP
- **Consider:**
  - 1 adult therapeutic dose platelets
  - tranexamic acid in trauma patients
- **Include:**
  - cryoprecipitate if fibrinogen < 1 g/L
  - OR locally agreed configuration

#### Bleeding controlled?

**YES**

Notify transfusion laboratory to: ‘Cease MTP’

**NO**

**OPTIMISE:**
- oxygenation
- cardiac output
- tissue perfusion
- metabolic state

**MONITOR** (every 30–60 mins):
- full blood count
- coagulation screen
- ionised calcium
- arterial blood gases

**AIM FOR:**
- temperature > 35°C
- pH > 7.2
- base excess < −6
- lactate < 4 mmol/L
- Ca²⁺ > 1.1 mmol/L
- platelets > 50 × 10⁹/L
- PT/APTT < 1.5 × normal
- INR ≤ 1.5
- fibrinogen > 1.0 g/L
The routine use of rFVIIa in trauma patients is not recommended due to its lack of effect on mortality (Grade B) and variable effect on morbidity (Grade C). Institutions may choose to develop a process for the use of rFVIIa where there is:

• uncontrolled haemorrhage in salvageable patient,
• failed surgical or radiological measures to control bleeding, and
• adequate blood component replacement, and
• pH > 7.2, temperature > 34°C.

Discuss dose with haematologist/transfusion specialist.

rFVIIa is not licensed for use in this situation; all use must be part of practice review.

How I treat patients with massive hemorrhage

Pär I. Johanson,1,2 Jakob Stensballe,1,3 Roberto Oliveri,1 Charles E. Wade,4 Sisse R. Ostrowski,1 and John B. Holcomb2

1Section for Trauma Medicine, Capital Region Blood Bank, Copenhagen University Hospitals, Rigshospitalet, Copenhagen, Denmark. 2Department of Surgery, Division of Acute Care Surgery, Centre for Translational Injury Research, University of Texas Health Medical School, Houston, TX, and 3The Trauma Centre, Department of Anesthesia, Center of Head and Orthopedics, Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark

Blood 2014 Nov; 124(20)
MTP outside the trauma room...

Consider...

54 y/o male undergoing routine laparoscopic surgery at your community hospital

Unexpected mass hemorrhage intraop
Community/Specialty Hospital MTP

- MTP may improve rapid response in settings where hemorrhage is anticipated but rarely seen
- Consider the resources at your hospital based on multi-disciplinary group feedback
- Organize and develop a plan for action
- …then in-service / drill / debrief / repeat

### Obtaining Blood Products Checklist

**Massive Transfusion Protocol (MTP)**

*For any issues or concerns, please contact the Attending Apheresis Pathologist from the "Pathology/Clinical Lab" on call schedule search on WebXchange*

<table>
<thead>
<tr>
<th>Blood Products Included in MTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>- (2) PRBC’s; (2) FFP; (1) pool of Platelets</td>
</tr>
<tr>
<td>- Platelets will Not be Immediately Available and Blood Bank Will Notify Staff When Available for Pick Up</td>
</tr>
<tr>
<td>- NOTE: While only 2 units will be sent each time, a continuous supply of blood product will be prepared and the receiving unit will need to contact Blood Bank to arrange subsequent times to pick up additional product.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Transfer of Patient Receiving MTP</td>
</tr>
<tr>
<td>- Inform Receiving Unit that MTP is activate</td>
</tr>
<tr>
<td>- RN to Call Blood Bank to inform of new patient location.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conclusion of MTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Once Attending Physician Cancels the MTP, the patient’s primary nurse should call Blood Bank to cancel the MTP</td>
</tr>
<tr>
<td>- Blood Bank will contact the Attending Physician after the MTP is concluded to obtain an order for all products used during the MTP</td>
</tr>
</tbody>
</table>

| ALL RBC AND PLASMA UNITS MUST REMAIN IN THE BLOOD BANK COOLERS UNTIL READY TO TRANSFUSE |

- Call the Blood Bank to notify the initiation of MTP
  - Caller must state the words: “MASSIVE TRANSFUSION PROTOCOL” and the name of the ATTENDING PHYSICIAN initiating the MTP.
  - Caller must provide the Blood Bank with the patient name and location, sex, and MRN
- An Order to Initiate the MTP is Not Needed
  - Blood Bank will contact the Attending Physician after the MTP is concluded to obtain an order for all products used during the MTP
- Type and Cross
  - Obtain Type and Cross specimen
  - Send to Lab as soon as possible
- Blood Bank Will Not Transport or Call When Blood Products are Ready
  - OR/ED Staff will be sent to obtain blood products immediately following the initiation of the MTP
  - A Blood Product Release white paper slip must be taken to the Blood Bank

University Hospitals East
The Wexner Medical Center at The Ohio State University
Summary

- Patient blood management involves a multi-disciplinary approach to care of patients who may require transfusion
- Improves patient safety, reduces waste, lowers cost and optimizes efficient delivery
- Mass transfusion protocols have been well supported in military and civilian trauma literature
- May improve response to mass hemorrhage in settings where it is anticipated but rarely seen
- Develop then in-service / drill / debrief / repeat

Fluid and Blood Management in Active Bleeding

Daniel S. Eiferman, MD, FACS
Assistant Professor of Surgery
Department of Surgery
Division of Critical Care, Trauma, and Burn
The Ohio State University Wexner Medical Center
Objective
Provide a practical approach to the management of active bleeding

KEEP
CALM
AND
BE
PRACTICAL

Remember the Goal
Ensure that patients who need blood and blood products get every drop they need, and not a drop more
Other Interventions Besides Transfusion To Assist With Hemostasis

- temperature > 35°C
- pH > 7.2
- lactate < 4 mmol/L
- Ca²⁺ > 1.1 mmol/L

Surgical Bleeding (i.e. Holes in Blood Vessels!)

- Require operative management
- Transfusion strategy: Give blood and blood products in 1:1 ratio until bleeding controlled
Medical Bleeding (i.e. Coagulopathy) Who Remembers This?

The three pathways that make up the classical blood coagulation pathway:

- **Intrinsic**
  - XII → XIIa
  - XI → Xla
  - IX → IXa

- **Extrinsic**
  - TF: VIIa
  - tissue damage

- **Common**
  - fibrin polymerization

“Classic” Coagulation Assays:
- PT/INR
- PTT
- Platelets

Problem: PT/aPTT do not reflect fibrin polymerization, FXIIIa, platelet quality, or fibrinolysis
Problem: Turnaround time for results ~45-60 mins
Thromboelastography (TEG)

Assesses for impaired thrombin generation, poor clot firmness and premature lysis in the bleeding patient to guide transfusions

What additional information does TEG yield?

- Hyperfibrinolysis and/or poor fibrin contribution to clot firmness
- Heparin Effect, Anti-coagulant Effects
- Clot Firmness
- Thrombin Generation
- Can differentiate between intrinsic and extrinsic factor deficiency
How To Use TEG Output to Guide Therapy and Transfusions

Hyperfibrinolysis → Tranexamic acid 25 mg/kg as a single bolus

Clot Firmness → Fibrinogen concentrate or Cryoprecipitate OR Platelet concentrate 1-2 pooled

Thrombin Generation → PCC 20-25 IU / kg bw OR FFP 10-15 ml / kg bw

Pyramid of therapy in coagulopathy

- Basic conditions ($T_c$, pH, $Ca^{2+}$, Hb)
- Surgical hemostasis (Compression; packing; suture; clipping; fibrin sealant)
- Antiplatelet therapy? Warfarin? Heparin?
- Hyperfibrinolysis ?
- Clot Firmness (Fibrinogen or Platelets)
- Clot initiation - Thrombin Gen
- Platelet Dysfunction
- FVIII, FVIII / FXIII
- t-PA, u-PA
Remember:
Transfusion Risks

• Risks
  • TRALI (#1 mortality)
  • TACO (#2 mortality)
  • Infection
  • Immunomodulation
  • Transfusion rxns

Summary

Surgical Bleeding—Transfuse in 1:1 ratio until hemorrhage controlled
Coagulopathy—Classical parameters inadequate and long turnaround time for results
TEG identifies the defect in the coagulation pathway causing inadequate clot formation
Summary

- Transfusions are not benign and have significant side effects
- Transfuse what is needed and nothing more!
- Use TEG to give targeted therapy to address the issue and avoid unnecessary transfusions