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.

http://www.redcrossblood.org/learn-about-blood/blood-facts-and-statistics

Patient Blood Management: What?

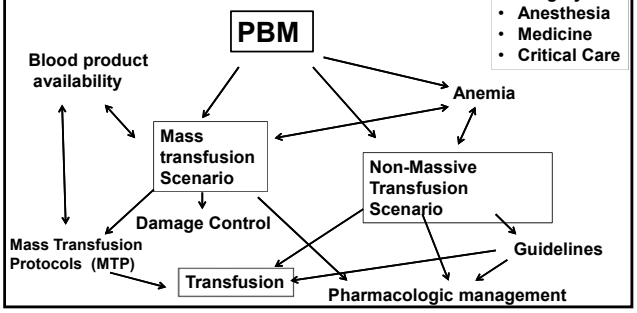
- Patient blood management (PBM) is an evidence-based, multidisciplinary approach to optimizing the care of patients who might need transfusion.

American Association of Blood Banks

Patient Blood Management (PBM)

- **Multi-disciplinary approach**

- Blood Bank
- Lab
- Nursing
- Hematology
- Surgery
- Anesthesia
- Medicine
- Critical Care



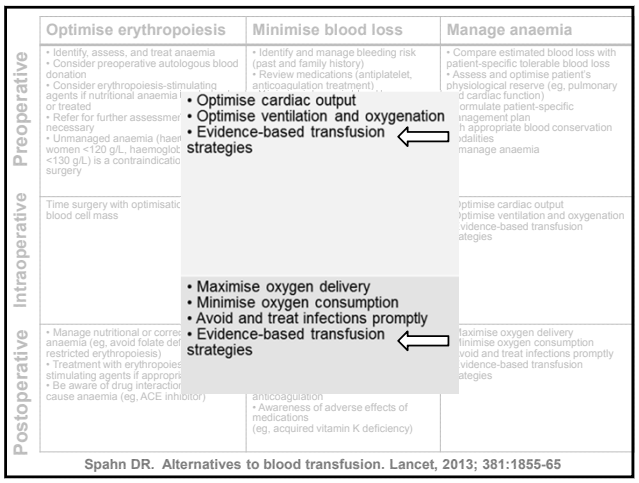
Blood Management

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

Broader perspective than transfusion

	Optimise erythropoiesis	Minimise blood loss	Manage anaemia
Preoperative	• Identify, assess, and treat anaemia • Consider preoperative autologous blood donation • Consider erythropoiesis-stimulating agents if nutritional anaemia is ruled out or treated • Refer for further assessment if necessary • Unmanaged anaemia (haemoglobin in women <120 g/L, haemoglobin in men <130 g/L) is a contraindication for elective surgery	• Identify and manage bleeding risk (past and family history) • Review medications (antiplatelet, anticoagulation treatment) • Minimise iatrogenic blood loss • Procedure planning and rehearsal	• Compare estimated blood loss with patient-specific tolerable blood loss • Assess and optimise patient's physiological reserve (eg, pulmonary and cardiac function) • Formulate patient-specific management plan with appropriate blood conservation modalities to manage anaemia
Intraoperative	Time surgery with optimisation of red blood cell mass	• Meticulous haemostasis and surgical techniques • Blood-sparing surgical techniques • Anaesthetic blood-conservation strategies • Acute normovolaemic haemodilution • Cell salvage and reinfusion • Pharmacological and haemostatic agents • Avoid coagulopathy	• Optimise cardiac output • Optimise ventilation and oxygenation • Evidence-based transfusion strategies
Postoperative	• Manage nutritional or correctable anaemia (eg, avoid folate deficiency, iron-restricted erythropoiesis) • Treatment with erythropoiesis-stimulating agents if appropriate • Be aware of drug interactions that can cause anaemia (eg, ACE inhibitor)	• Monitor and manage bleeding • Maintain normothermia (unless hypothermia indicated) • Autologous blood salvage • Minimise iatrogenic blood loss • Management of haemostasis and anticoagulation • Awareness of adverse effects of medications (eg, acquired vitamin K deficiency)	• Maximise oxygen delivery • Minimise oxygen consumption • Avoid and treat infections promptly • Evidence-based transfusion strategies

Spahn DR. Alternatives to blood transfusion. Lancet, 2013; 381:1855-65



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

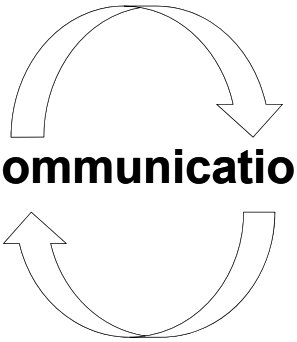
2 year observational study, large community health system

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

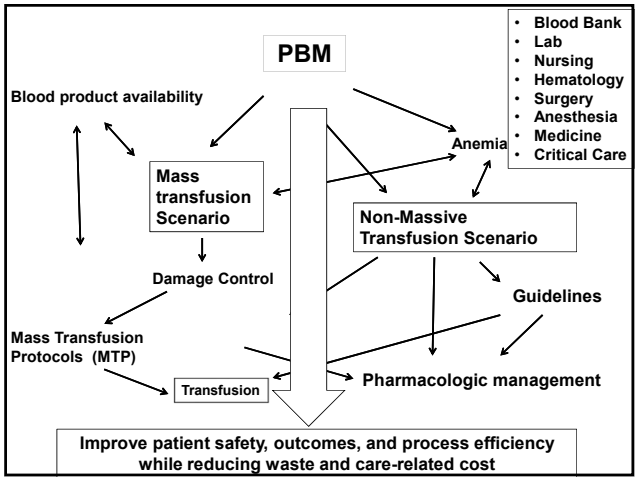
Reduced coagulopathy in PPH patients (DIC reduced by 64%, p<0.01)

Patient Monitoring

- **Clinical suspicion**
- **Physiologic parameters (ex. Ca_i, acid/base balance, temperature)**
- **Lab based / Point-of-care testing**
- **Transfusion thresholds (?)**



Patient Blood Management: Why?



Contributing to patient safety…

Intraoperative Transfusion of 1 U to 2 U Packed Red Blood Cells Is Associated with Increased 30-Day Mortality, Surgical-Site Infection, Pneumonia, and Sepsis in General Surgery Patients

Andrew C Bernard, MD, FACS, Daniel L Davenport, PhD, Phillip K Chang, MD, FACS, Taylor B Vaughan, BS, Joseph B Zwischenberger, MD, FACS

J Am Coll Surg 2009;208:931-937

- 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

- Risks
  - TRALI (#1 mortality)
  - TACO (#2 mortality)
  - Infection
  - Immunomodulation
  - Transfusion rxns
- Benefits
  - Improved O2 carrying capacity
  - Improved coagulation
  - Hemodynamic stability

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?

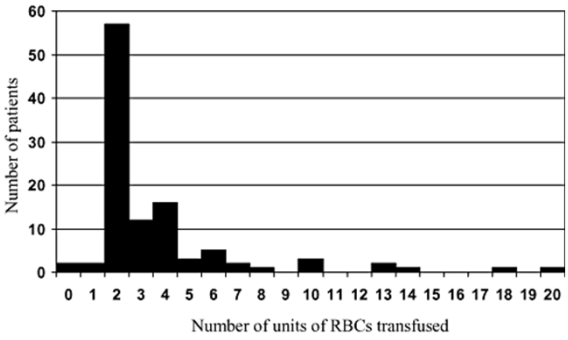
Appropriateness of Allogeneic Red Blood Cell Transfusion: The International Consensus Conference on Transfusion Outcomes
Shander A., et al.

***Transfus Med Rev* 2011 Jul;25(3):232-246**

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

59% Inappropriate

One unit… or two?

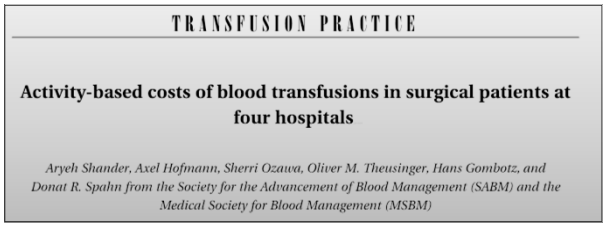


James AH et al. Blood component therapy in postpartum hemorrhage. Transfusion 2009;49(11):2430-3.

Opportunity for cost savings?

What do products cost?

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



TRANSFUSION PRACTICE

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

Aryeh Shander, Axel Hofmann, Sherri Ozawa, Oliver M. Theusinger, Hans Gombotz, 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

captodayonline.com http://www.captodayonline.com/for-safety-and-savings-lab-takes-on-transfusions/

For safety and savings, lab takes on transfusions

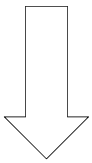
Ann Griswold, PhD

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

Carson JL, Carless PA, Hebert PC. Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion. Cochrane Database of Systematic Reviews 2012, Issue 4.

Transfusion Requirements After Cardiac Surgery: The TRACS Randomized Controlled Trial

Ludhmila A. Hajjar, MD et al. *JAMA.* 2010;304(14):1559-1567.

Transfusion Strategies for Acute Upper Gastrointestinal Bleeding

N Engl J Med 2013; 368:11-21, January 3, 2013

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

N Engl J Med 2011; 365:2453-2462, December 29, 2011

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

N Engl J Med 1999; 340:409-417, February 11, 1999

- 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**

Faust RJ. Perioperative indications for red blood cell transfusion – Has the pendulum swung toofar? (editorial). Mayo Clin roc 1993;68:512.

"Thinking" conservatively…

Ensure that patients who need blood get every drop they need, and not a drop more

Transfusion Therapy: Indications for Ordering

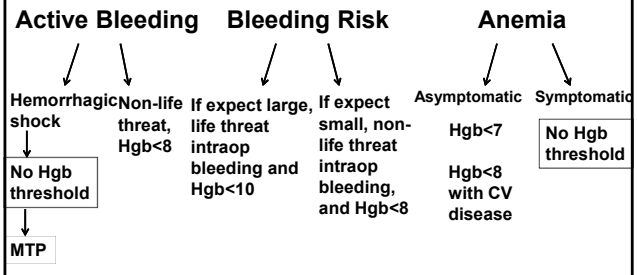
The Ohio State University Wexner Medical Center

- 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 the 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

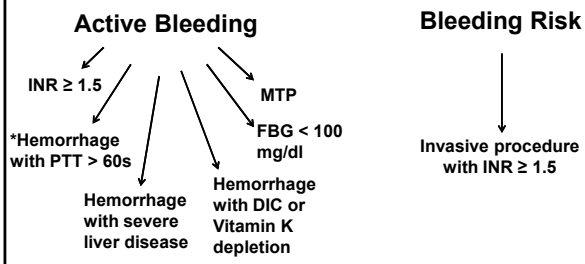


Transfusion Therapy: Indications for Ordering - The Ohio State University Wexner Medical Center

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

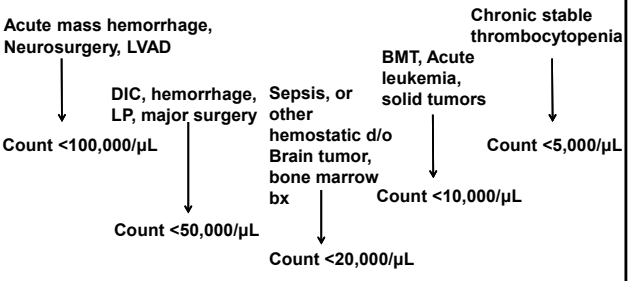
Plasma



*excluding heparin or lupus anticoagulant effect

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

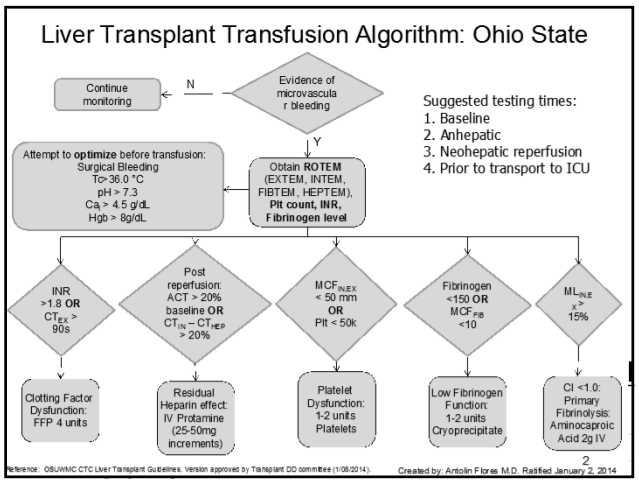
Platelets

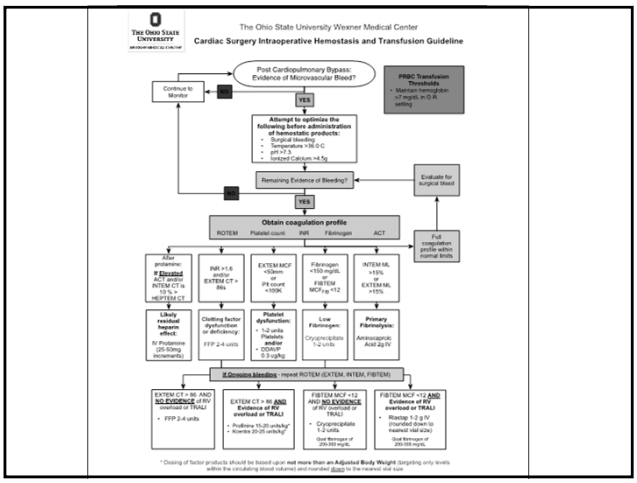


Platelet function d/o > 100,000/μL

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…

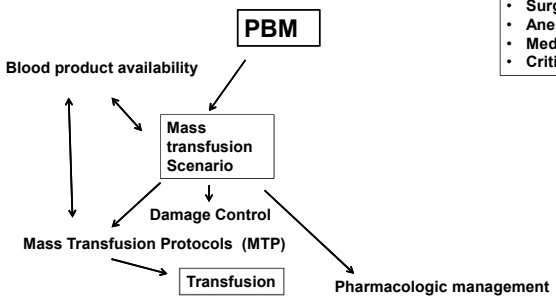
23 y/o male GSW to chest

Responsive, HR 125, BP 88/40

Patient Blood Management (PBM)

- Multi-disciplinary approach

- Blood Bank
- Lab
- Nursing
- Hematology
- Surgery
- Anesthesia
- Medicine
- Critical Care

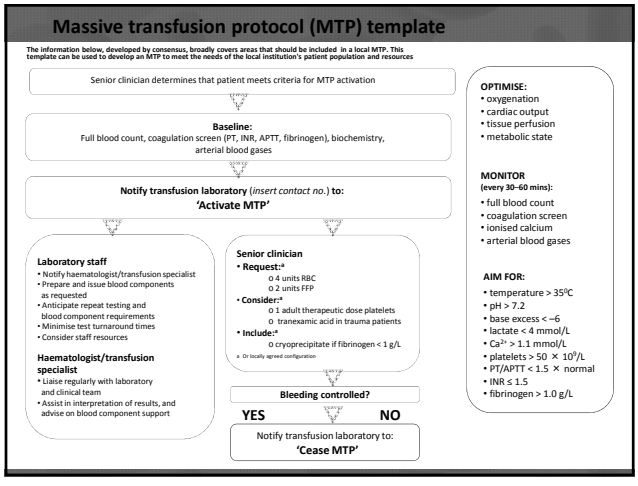


Mass Transfusion Protocols

- 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



- Actual or anticipated 4 units RBC in < 4 hrs, + haemodynamically unstable, +/– anticipated ongoing bleeding
- Severe thoracic, abdominal, pelvic or multiple long bone trauma
- Major obstetric, gastrointestinal or surgical bleeding

Initial management of bleeding

- Identify cause
- Initial measures:
  - compression
  - tourniquet
  - packing
- Surgical assessment:
  - early surgery or angiography to stop bleeding

Specific surgical considerations

- If significant physiological derangement, consider damage control surgery or angiography

Cell salvage

- Consider use of cell salvage where appropriate

Dosage

Platelet count < 50 x 10^9/L	1 adult therapeutic dose
INR > 1.5	FFP 15 mL/kg[a]
Fibrinogen < 1.0 g/L	cryoprecipitate 3–4 g[a]
Tranexamic acid	loading dose 1 g over 10 min, then infusion of 1 g over 8 hrs

a Local transfusion laboratory to advise on number of units needed to provide this dose

Resuscitation

- Avoid hypothermia, institute active warming
- Avoid excessive crystalloid
- Tolerate permissive hypotension (BP 80–100 mmHg systolic) until active bleeding controlled
- Do not use haemoglobin alone as a transfusion trigger

Special clinical situations

- Warfarin:
  - add vitamin K, prothrombinex/FFP
- Obstetric haemorrhage:
  - early DIC often present; consider cryoprecipitate
- Head injury:
  - aim for platelet count > 100 × 10^9/L
  - permissive hypotension contraindicated

Considerations for use of rFVIIa[b]

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, and
- 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

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

ABG	arterial blood gas	FFP	fresh frozen plasma	APTT	activated partial thromboplastin time
INR	international normalised ratio	BP	blood pressure	MTP	massive transfusion protocol
DIC	disseminated intravascular coagulation	PT	prothrombin time	FBC	full blood count
RBC	red blood cell	rFVIIa	activated recombinant factor VII		

How I treat patients with massive hemorrhage

Pär I. Johansson,[1,2] Jakob Stensballe,[1,3] Roberto Oliveri,[1] Charles E. Wade,[2] Sisse R. Ostrowski,[1] and John B. Holcomb[2]

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

- 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
- Blood Products Included in MTP
  - (2) PRBC's; (2) FFP; (1) pool of Platelets
  - Platelets will Not be Immediately Available and Blood Bank Will Notify Staff When Available for Pick Up
  - 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.
- Communication
  - Transfer of Patient Receiving MTP
    - Inform Receiving Unit that MTP is activate
    - RN to Call Blood Bank to inform of new patient location.
  - Conclusion of MTP
    - Once Attending Physician Cancels the MTP, the patient's primary nurse should call Blood Bank to cancel the MTP
    - Blood Bank will contact the Attending Physician after the MTP is concluded to obtain an order for all products used during the MTP

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

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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

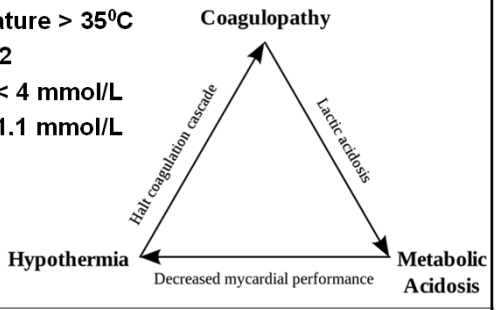
Provide a practical approach to the management of active bleeding

Remember the Goal

Ensure that patients who need blood and blood products get every drop they need, and not a drop more

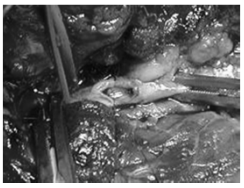
Other Interventions Besides Transfusion To Assist With Hemostasis

- temperature > 35^0C
- pH > 7.2
- lactate < 4 mmol/L
- Ca^{2+} > 1.1 mmol/L

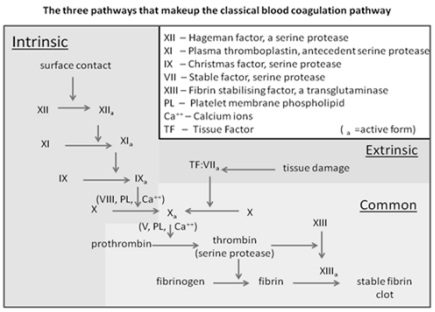


Surgical Bleeding (i.e. Holes in Blood Vessels!)

- 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?



How To Determine What To Transfuse When Coagulopathy present?

"Classic" Coagulation Assays:

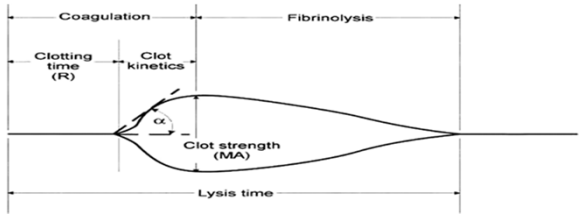
- **PT/INR**
- **PTT**
- **Platelets**

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 <u>bleeding patient to guide transfusions</u>

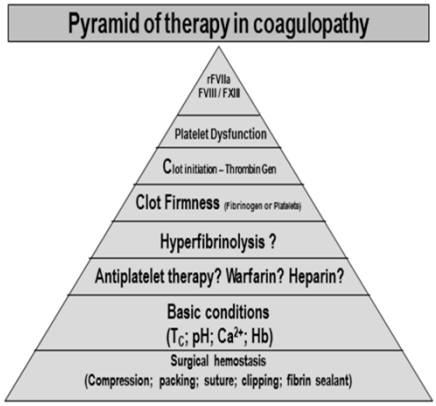


What additional information does TEG yield?

- **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



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**