What You Need to Know
This guideline is developed to treat the hemodynamically stable bleeding patient who is not in hemorrhagic shock, liver transplant patients and cardiac surgery patients, how to respond to ROTEM values, and guide hemostasis management.

Blood Conservation

- **Transfusion Therapy: Indications for Ordering**
- Lab ordering should be assessed daily and limited as able
  - Hospital acquired anemia has been demonstrated in ~20-30% of patients\(^1,2\)
  - Average daily blood volume lost due to phlebotomy in the ICU is estimated at 40 mL\(^3\)
- Use of O negative blood should be limited to patients without an available type and screen. A type and screen should be ordered as soon as possible, and transfusion should be switched once appropriate.

Patient Blood Management Strategies

### Anemia Management in the Critically Ill Patient

- In the absence of active bleeding, PRBCs should only be ordered 1 unit at a time and response reassessed prior to ordering of additional units.
- Empiric use of folic acid 1 mg daily and cyanocobalamin 100 mcg daily is recommended.
  - Oral route is preferred when appropriate\(^4,5\)

<table>
<thead>
<tr>
<th>Symptomatic Anemia</th>
<th>Asymptomatic Anemia</th>
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<tbody>
<tr>
<td>No hemoglobin threshold exists in the setting of symptomatic, otherwise unexplained anemia. If patient is actively bleeding refer to Appendices A, B or C.</td>
<td>Only consider the need for transfusion if hemoglobin is less than 7 g/dL.</td>
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<tr>
<td>Screening for iron deficiency anemia in patients without active infection and hemoglobin &lt; 10 g/L should be considered.</td>
<td>Transfusion should not be solely based on hemoglobin level in patients who are asymptomatic</td>
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<tr>
<td>Replace with IV iron or ferrous gluconate 650 mg TID in patients with ferritin &lt; 800 and transferrin saturation &lt; 50% ([serum iron/TIBC] x 100).</td>
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<tr>
<td>- Iron received from blood products should be considered when replacing with IV iron.</td>
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<tr>
<td>- 1 unit of PRBCs contains approximately 250 mg of elemental iron.</td>
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<tr>
<td>- Patients with ESRD</td>
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<tr>
<td>- Assess iron studies and replace if indicated per <a href="https://tco.osu.edu/">Iron Management Guideline for Chronic Kidney Disease Patients</a></td>
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<tr>
<td>- Discuss erythropoietin stimulating therapy with nephrology early</td>
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### Thrombocytopenia Management

- In the absence of active bleeding, platelets should only be ordered as 1 unit at a time and response reassessed prior to ordering of additional units.
- Empiric transfusion in the absence of active bleeding is not recommended if platelets are > 10,000 u/L
- Platelet transfusion should be considered if platelets are < 10,000 u/L
Considerations for Patients with Significant Bleeding

The following fundamentals should be addressed for a patient with significant bleeding to optimize effectiveness of intrinsic coagulation and adjunct agent use

- Achieve normal body temperature
- Correct severe acid-base disturbances
- Aggressively replace ionized calcium
- Correct any overt or underlying causes of hemorrhage as able (e.g., discontinuation or reversal of contributing medications, or correction of a surgical bleed)

Reversal of anticoagulation if applicable

- Anticoagulation Reversal: Unfractionated Heparin (UFH) and Low Molecular Weight Heparin (LMWH)
- Warfarin management of Elevated INR and Reversal
- Anticoagulation Reversal: Factor Xa Inhibitors – Rivaroxaban (Xarelto®), Apixaban (Eliquis®), Edoxaban (Savaysa®)
- Anticoagulation Reversal: Dabigatran

ROTEM

Consider a targeted transfusion approach for resuscitation with ROTEM as needed for the hemodynamically stable patient

- Refer to Appendix A for transfusion guidance excluding cardiac surgery and patients undergoing liver transplant
- Refer to Appendix B for transfusion guidance in patients undergoing cardiac surgery
- Refer to Appendix C for transfusion guidance in patients undergoing liver transplant
- Due to short stability, factor products should be ordered as STAT immediately prior to intended use

Trauma Specific Considerations

- Consider use of tranexamic acid 1g bolus followed by 1g infusion over 8 hours in patients presenting within 3 hours of injury
- A type and screen should be sent as soon as possible to avoid unnecessary use of O negative blood
- Utilize hemorrhage control adjuncts whenever possible

Abbreviations:

CT – Clotting Time
DDAVP – Desmopressin
FFP – Fresh Frozen Plasma
Hgb – Hemoglobin
INR – International Normalized Ratio
MCF – Maximum Clot Firmness
MTP – Massive Transfusion Protocol
Plt – Platelet
PRBC – Packed Red Blood Cells
PTT – Partial Thromboplastin Time
TRALI – Transfusion Related Acute Lung Injury
References


OSUWMC Resources
- Transfusion Therapy: Indications for Ordering Guideline
- Massive transfusion protocol
- Anticoagulation Reversal Guidelines

Quality Measures
- Number of blood products used

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Guideline reviewed by: Antithrombotic, Thrombosis and Hemostasis Committee

Guideline Approved


Disclaimer: Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC’s guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.
Appendix A: Targeted Hemostasis Guidance

If patient is having clinically significant bleeding, MTP should be initiated by calling blood bank (38467)

Hemodynamically stable with clinical evidence of bleeding

If coagulation profile is normal try to identify source of bleeding and control as able

Transfuse PRBC with goal hemoglobin >7g/dL
Obtain coagulation profile for targeted hemostasis
Attempt to optimize the following before administration of hemostatic products:
- Temperature >36.0°C
- pH >7.3
- Ionized Calcium >4.5g/dL

If systemic heparin administered within 3hr of bleeding and: PTT > 40 sec

Likely residual heparin effect: Protamine-refer to UFH reversal guideline for dose

If systemic heparin administered within 3hr of bleeding and: PTT > 40 sec

InR > 1.8

Clotting factor dysfunction or deficiency: FFP 2-4 units
And consider Vitamin K 10mg IV x 1

Plt count < 50K

Thrombocytopenia and/or Platelet dysfunction:
1-2 units of platelets
And consider DDAVP 0.3 ug/kg

Fibrinogen < 150 mg/dL

Low Fibrinogen (poor clot strength): Cryoprecipitate 1-2 pools

Hgb < 7 g/dL

Acute Blood Loss Anemia: 1 unit of PRBC

Evidence or concern for ongoing bleeding

Is ROTEM available?

NO

Continue to monitor

YES

Transfuse for targeted hemostasis

If system RTEM > 90

EXTEM CT > 90 AND NO EVIDENCE of fluid overload, TRALI, or blood product shortage FFP 2-4 units

EXTEM CT > 90 AND evidence of fluid overload, TRALI, or blood product shortage FFP 2-4 units

Kcentra 20-25 units/kg*#†

EXTEM MCF < 45 and FIBTEM MCF > 12 1 of platelets

EXTEM MCF < 45 and FIBTEM MCF > 12 1 of platelets

Ristap 1-2 g IV (rounded down to nearest vial size)**

FIBTEM MCF < 12 AND evidence of fluid overload, TRALI, or blood product shortage

FIBTEM MCF < 12 AND evidence of fluid overload, TRALI, or blood product shortage

Cryoprecipitate 1-2 pools

FIBTEM MCF < 12 AND evidence of fluid overload, TRALI, or blood product shortage

Ristap 1-2 g IV (rounded down to nearest vial size)**

EXTEM or INTEM ML > 15%

Tranexamic acid 1 gm*†

OR

aminocaproic acid 4-5 gm*†

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* Dosing of factor products should be based upon actual weight. Max single dose of 2500 units with daily max of 5000 units
**One gram of Ristap correlates to roughly 1 pool of cryoprecipitate
# Patients with disseminated intravascular coagulation (DIC), use of prothrombin complex concentrate (PCC), tranexamic acid, aminocaproic acid and recombinant factor VII should be avoided
†Attending approval required for the administration of PCC or antifibrinolytic for patients on mechanical circulatory support
Appendix B: Intraoperative Hemostasis and Transfusion Guidance for Cardiac Surgery

Continue to Monitor

Post Cardiopulmonary Bypass: Evidence of Microvascular Bleed?

PRBC Transfusion Thresholds:
Maintain Hgb > 7 mg/dL in O.R. setting

Remaining Evidence of Bleeding?

Evaluate for surgical bleed

Obtain coagulation profile

ROTEM Platelet count INR Fibrinogen ACT

Full coagulation profile within normal limits

After protamine:
If Elevated ACT and/or INTEM CT is 10% > HEPTEM CT

Likely residual heparin effect:
IV Protamine (25-50mg increments)

Clotting factor dysfunction or deficiency:
FFP 2-4 units

Platelet dysfunction:
1-2 units Platelets and/or DDAVP 0.3 ug/kg

Low Fibrinogen:
Cryoprecipitate 1-2 units

Primary Fibrinolysis:
Aminocaproic Acid 2g IV

If Ongoing bleeding - repeat ROTEM (EXTEM, INTEM, FIBTEM)

EXTEM CT > 86 AND NO EVIDENCE of RV overload or TRALI
• FFP 2-4 units

EXTEM CT > 86 AND Evidence of RV overload or TRALI
• Kcentra 20-25 units/kg*

FIBTEM MCF<12 AND NO EVIDENCE of RV overload or TRALI
• Cryoprecipitate 1-2 units
Goal fibrinogen of 200-300 mg/dL

FIBTEM MCF<12 AND Evidence of RV overload or TRALI
• Riastap 1-2 g IV (rounded down to nearest vial size)
Goal fibrinogen of 200-300 mg/dL

* Dosing of factor products should be based upon Actual Body Weight up to but not exceeding 100kg and rounded down to the nearest vial size

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Appendix C: Transfusion for Liver Transplant

Continue to Monitor

NO

Evidence of Microvascular Bleeding?

YES

Obtain ROTEM (EXTEM, INTEM, FIBTEM, HEPTEM), Ptl count, INR, Fibrinogen level

Suggested Testing Times:
1) Baseline
2) Anhepatic
3) Neohepatic reperfusion
4) Prior to transport to ICU

Attempt to optimize before transfusion:
- Address active surgical bleeding
- Maintain/achieve the following:
  - Temperature > 36.0°C
  - pH > 7.3
  - Ionized Calcium > 4.5g/dL
  - Hemoglobin > 8g/dL

INR . 1.8
OR CTEx > 90s

Clotting Factor Dysfunction:
- FFP 4 units
- *Prothrombin Complex Concentrate 1,000 units*

Post reperfusion:
- ACT > 20% baseline
- OR CTIN – CTHEP > 20%

Residual Heparin effect:
- IV Protamine (25-50mg increments)
- *Should only be considered when:
  - There are product shortages
  - There is concern for volume overload or RV dysfunction

Fibrinogen < 150
OR MCFIB < 10

Low Fibrinogen:
- Cryoprecipitate 1-2 units
- 1-2 units Platelets
- *1-2g Fibrinogen Concentrate*

MCFIN,EX < 50 mm
OR Ptl < 50k

Platelet dysfunction:
- 1-2 units Platelets

MCFIN,EX > 15%

CI < 1.0: Primary Fibrinolysis:
- Aminocaproic Acid 2g IV

Evidence of Microvascular Bleeding?

*Prothrombin Complex Concentrate*