Dr. Lani Lieberman, Neonatal and Pediatric Transfusions

Proposed NICU RBC Transfusion Thresholds

Respiratory status	Age of neonate	Hemoglobin Threshold
Ventilated	Age < 1 wk Age > 1 wk	Hgb < 120 g/L Hgb < 110 g/L
On O_2/ CPAP	Age < 1 wk Age > 1 wk	Hgb <100 g/L Hgb < 90 g/L
Stable and off O_2	Age > 1 wk	Hgb < 75 g/L

BJH 2013; 160: 421–433

RBC Threshold Guidelines for Children

Pediatric Patient type	Threshold	Evidence grade
PICU (stable, non-cyanotic)	70 g/L	1B
Oncology	70 g/L (typical practice) Insufficient literature	2C
Perioperative non-cardiac surgery (stable, non-bleeding)	70 g/L	1C
Chronic anemia (Diamond Blackfan anemia)	80 g/L Consensus based	2C

* Hemoglobinopathies

The following should be considered for children undergoing surgery with significant risk of bleeding:

Tranexamic acid (1B)

Red cell salvage (2C)

BJH 2016; 175: 784-828

Proposed NICU Platelet Transfusion Thresholds

Clinical status	Platelet threshold	Grade Comment
Major bleeding or requiring major surgery (e.g. neurosurgery)	< 100 x 10^9/L	No RCT in prems
Bleeding, current coagulopathy, sx, exchange transfusion	< 50 x 10^9/L	
No bleeding (including NAIT if no bleeding and FHx of ICH)	< 30 x 10^9/L	Grade 2C

Special considerations for NAIT – neonatal alloimmune thrombocytopenia

BJH 2013; 160: 421–433
BJH 2019; 185(3):549-562,

Suggested platelet thresholds for platelet transfusion in children

Platelet threshold (x 10^9/L)	Clinical situation
< 10	Irrespective of signs of hemorrhage (excluding ITP, TTP/HUS, HIT)
< 20	Severe mucositis Sepsis Laboratory evidence of DIC in the absence of bleeding Risk of bleeding due to a local tumour infiltration
< 40	Prior to lumbar puncture
< 50	Moderate hemorrhage (e.g. GI bleeding) Surgery, unless minor (except at critical sites)
< 75-100	Major hemorrhage or significant post-op bleeding Surgery at critical sites: CNS including eyes

** expert opinion

BJH 2016; 175, 784-828

Clinical Pearls

- Laboratory reference ranges (hematology and coagulation) specific for neonates and children should be used
- Always consider the etiology of the anemia and thrombocytopenia prior to ordering a transfusion
- Order blood products using child's weight

Blood Products are ordered by weight (ml/ kg)

Product	Pediatric Dose (ml/kg)	Typical Adult Dose
RBC	10-15 ml/ kg	1 Unit ≈ 280-300 mL
Platelets	10-15 ml/kg	1 Unit ≈ 250-350 ml
Plasma	10-15 ml/kg	3-4 Units ≈ 750-1000ml
Cryoprecipitate*	1-2 U/10 kg	Adult Pool 150-200ml

Dr. Jeannie Callum, Massive Hemorrhage: Pathophysiology & Evidence Based Management

Summary

Massive Hemorrhage Protocols are designed to ensure every patient receives coordinated, standardized and evidence-based care. The protocol should be activated promptly when faced with a massively bleeding patient – every 1 minute delay to the first RBC is associated with a 5% increase in mortality. But on the flip-side, activation is not required for every bleeding patient. Activation results in deployment of portering, critical care, and laboratory resources. Over-activation will result in unnecessary blood product wastage. Activate the protocol when faced with a patient with a critical injury (high speed collision, penetrating trauma, post-partum hemorrhage) and with marked hemodynamic instability. Most gastrointestinal hemorrhages can be managed with a call to the blood bank for uncrossmatched red blood cells. The protocol should be activated through a coordinated communication process similar to other patient emergencies. Once the trained team has been assembled, a physician lead should be explicitly designated and a communication lead designated (to coordinate care with portering and the laboratory). Once activated, the system should be fast enough to ensure the first red cell is commenced within 15 minutes. Tranexamic acid should be administered within 60 minutes of injury/activation, with the exception of gastrointestinal hemorrhage where it has been proven to be ineffective (and increases thromboembolic complications). Tranexamic acid is of no value after 3 hours. Blood work should be done at baseline and then every 1 hour and/or 4 units of red cells. Wherever possible, transfusions should be guided by the results of laboratory testing. Use blood warmers and active warming blankets to maintain patient temperature over 36°C at all times. Monitor the temperature either continuously or at a minimum of every 30 minutes. Terminate the protocol when hemorrhage control has been achieved, hemodynamics are improving, coagulation tests are trending in the right direction, and the rate of transfusion has slowed. Ensure blood is packed as delivered by the blood bank throughout resuscitation and return all blood products promptly as soon as they are no longer needed.

Objectives

1. Explain the coagulation derangement seen with acute coagulopathy of trauma
2. Understand the key components of a Massive Hemorrhage Protocol
3. Review the science behind how we manage hemorrhaging patients

Dr. Katerina Pavenski, Massive Hemorrhage Protocols: Real World Applications

https://transfusionontario.org/en/provincial-massive-hemorrhage-toolkit/

Large/Academic Hospital Setting — Adult Appendix B

NEED A MASSIVE HEMORRHAGE PROTOCOL?

NO — NOT YET	
	1. ORDER 4 UNCROSSMATCHED RBC 2. REASSESS NEED FOR MHP

YES — NEED IT NOW	
	1. MASSIVE BLOOD LOSS 2. HYPOTENSION 3. LIKELY NEED PLASMA

Or based on hospital activation criteria

ANTICOAGULATION REVERSAL	
Warfarin	PCC 2000 units IV over 10 min Vitamin K 10mg IV over 10 min
Dabigatran (Pradaxa)	Idarucizumab 5g IV over 10 min
Apixaban (Eliquis) Rivaroxaban (Xarelto) Edoxaban (Lixiana)	PCC 2000 units IV over 10 min Repeat in 1 hour if bleeding continues
Heparins	Call pharmacy for dosing of protamine

MHP COOLER DELIVERY SEQUENCE	
Cooler 1	4 units ONeg RBC for women < 45 *All others receive OPos*
Cooler 2	4 units RBC 4 plasma
Cooler 3	4 units RBC 2 plasma 4g fibrinogen concentrate
Cooler 4+	4 units RBC 2 plasma

PLATELETS order if <50 or on antiplatelets
FIBRINOGEN CONCENTRATE order 4g IV if <1.5

PATIENT STABLE AND HEMORRHAGE CONTROLLED

1. Deactivate as per local policy
2. Perform bedside termination checklist
3. Inform family member and SDM of needing MHP
4. Return unused MHP components to blood bank

Laboratory transfusion triggers (once results available or rate of bleeding controlled)

Value	Transfuse
Hgb < 80	RBCs
INR ≥ 1.8	Plasma 4 units
Fibrinogen < 1.5 *Less than 2.0 for postpartum hemorrhage	Fibrinogen concentrate 4g
Platelets < 50	Platelets 1 adult dose
Ionized calcium < 1.15	$CaCl_2$ 1g

If available, ROTEM triggers

Value	Transfuse
EXTEM CT > 80	Plasma 4 units
EXTEM A10 < 35	Platelets 1 adult dose
FIBTEM A10 < 8-10	Fibrinogen concentrate 4g

CALL XXXX: INITIATE CODE TRANSFUSION

1. Control rapidly bleeding site (tourniquet)
2. IV/IO access
3. Tranexamic acid total dose of 2g IV / IO
4. 4U RBCs with rapid infuser
5. Limit use of crystalloids
6. Calcium chloride 1g IV
7. Keep patient temperature above 36°C
8. Obtain MHP blood work
9. Reverse anticoagulation
10. Call for definitive bleeding control (OR, angio, endoscopy)

EVERY HOUR REASSESS

1. **Can MHP be turned off?**
   Can laboratory guided transfusion be used instead?
   Is bleeding controlled?
   Stable hemodynamics?
2. Do we need to call for the next cooler?
3. Patient temperature >36°C
4. Collect q1h blood work
5. $CaCl_2$ 1g IV for every 4 RBC or ionized calcium < 1.15
6. Monitor for complications (hyperkalemia, volume overload)
7. Is resuscitation adequate? (hemodynamics, lactate, VBG)
8. Switch to group specific blood products, when able

Ontario MHP