

Transfusion Practice in Pediatrics

Sarah Tehseen
MD, MSc.
Transfusion Medicine/Pediatric
Hematology
Saskatchewan Health Authority

Objectives

- Describe differences in neonatal and pediatric physiology
 - Provide indications for transfusion in pediatric patients and transfusion thresholds
 - Discuss transfusion in neonates
 - Identify areas of research and unanswered questions
-
- For another time...
 - Address special populations
 - Oncology patients
 - Patients with hemoglobinopathy
 - Intrauterine/Exchange transfusions in neonates
 - Blood product modifications

Differences in neonatal and pediatric physiology

Caterpillars are NOT small butterflies



Children are NOT small adults



Question 1

- I see a 12 week old infant in hematology clinic today. His hemoglobin is 95 g/dl. He was born at full term (no complications) and is exclusively breastfed. What is the reason behind his current Hemoglobin level?
- a. Iron deficiency anemia
- b. Folate deficiency
- c. Physiologic anemia of infancy
- d. Viral suppression

Normal Hemoglobin levels

Table 1: Normal hemoglobin values for infants

Age	Hemoglobin concentration (g/l) (mean (- 2 SD))		
	Preterm*	Term	
	1.0-1.5 kg	1.5-2.0 kg	
2 weeks	163 (117)	148 (118)	165 (125)
1 month	109 (87)	115 (82)	140 (100)
2 months	88 (71)	94 (80)	115 (90)
3 months	98 (89)	102 (93)	115 (95)
* Preterm infant is defined as an infant less than 37 weeks gestational age. Normal values for preterm infants will depend on gestational age. Normal values may differ depending on the laboratory performing the investigations.			
This table was extracted with permission from Nathan and Oski's Hematology of Infancy and Childhood, 7th Edition (2008). ¹			

Normal Hemoglobin levels

- Hemoglobin decreases in infants in the first 3 months of life
 - Low Erythropoietin, increased blood volume
 - Lower limit depends on gestational age
 - Well tolerated in most cases

Normal hemoglobin levels

Table 2: Normal hemoglobin values for infants and children

Age	Sex	Hemoglobin concentration (g/l) (mean (- 2 SD))
0.5 to 2 years	Both	120 (105)
2 to 6 years	Both	125 (115)
6 to 12 years	Both	135 (115)
12 to 18 years	Female	140 (120)
	Male	145 (130)
> 18 years	Female	140 (120)
	Male	155 (135)

- Normal hemoglobin thresholds are similar to adults by 12 years of age

Differences in blood volume and cardiac output

- Blood volume in neonates is weight dependent
 - LBW infant = 85mL/Kg
 - normal BW = 100mL/Kg)
- Neonates are more sensitive to hypovolemia
 - Heart rate does not increase even with ~10% of BV loss
 - Poor tissue perfusion and oxygenation and higher hemoglobin levels

Question 2

- Which of the following factor levels is NORMAL at birth?
 - a. Factor VII
 - b. Factor IX
 - c. Factor V
 - d. Factor VIII
 - e. Protein C
 - f. Antithrombin

Differences in maturity of hemostasis

- Pro-coagulant factors are ~30-40% of their normal at birth
 - Except FVIII, Fibrinogen and VWD
- Anticoagulation factors are low
 - Protein S and AT normalize ~ 12 month
 - Protein C normalizes ~adolescence

AABB Technical manual-Chapter 23

Clinical guide to transfusion chapter 13

Table 3: Normal reference ranges for coagulation factor assays and screening tests

Coagulation test or factor assay	Age 1 to 3 days	Age 4 days to 18 years
Factor II	0.41 - 0.73 IU/ml	0.83 - 1.47 IU/ml
Factor V	0.64 - 1.54 IU/ml	0.71 - 1.68 IU/ml
Factor VII	0.52 - 1.07 IU/ml	0.57 - 1.59 IU/ml
Factor VIII	0.83 - 3.29 IU/ml	0.56 - 1.72 IU/ml
Factor IX	0.35 - 0.97 IU/ml	0.74 - 1.66 IU/ml
Factor X	0.46 - 0.75 IU/ml	0.69 - 1.54 IU/ml
Factor XI	0.07 - 0.79 IU/ml	0.63 - 1.52 IU/ml
Factor XII	0.13 - 0.97 IU/ml	0.40 - 1.49 IU/ml
	<3 months	3 months to 18 years
Fibrinogen	1.6 - 4.0 g/L	1.9 - 4.3 g/L
aPTT	25 - 45 sec	24 - 36 sec
INR	0.90 - 1.60	0.80 - 1.20
TCT	<21 sec	<21 sec

Abbreviations: International normalized ratio (INR); activated partial thromboplastin time (aPTT); thrombin clotting time (TCT).

In summary

- Transfusion thresholds are different in neonates compared to children
- Laboratory values for CBC and coagulation studies should be interpreted with age-appropriate references in mind
- The hemoglobin concentration alone is usually not sufficient to make a decision
 - Other clinical characteristics must be taken into account
 - Just like adults :p

Indications for transfusion in children

Question 3

- An 8 year old male has been admitted in PICU for asthma and needed BiPAP and continuous albuterol infusion. He is now **stable on room air** and scheduled Ventolin. CBC today showed a hemoglobin of **70**. What is your next step?
 - a. Transfuse PRBC at 10ml/kg
 - b. Transfuse PRBCs at 15ml/kg
 - c. Investigate the cause of anemia and treat accordingly
 - d. Provide IV iron

Question 4

- A 3 year old female is brought into ER with **tachypnea(RR:60) and tachycardia (HR: 150/min)**. She recently had a viral URI. Her parents think she looks yellow and is very **lethargic**. A CBC shows a hemoglobin of **75 g/dl** with a normal MCV and a reticulocyte count of 200. Her Hemoglobin performed in PCP office 3 days ago was 120 g/dl. What is your next step?
- a. Repeat CBC tomorrow morning and admit patient
 - b. Admit patient, consent, type and cross with DAT to transfuse 15 ml/kg of PRBCs
 - c. Give Iron supplementation
 - d. Give steroids

Transfusion of packed red blood cells

Physiologic stress

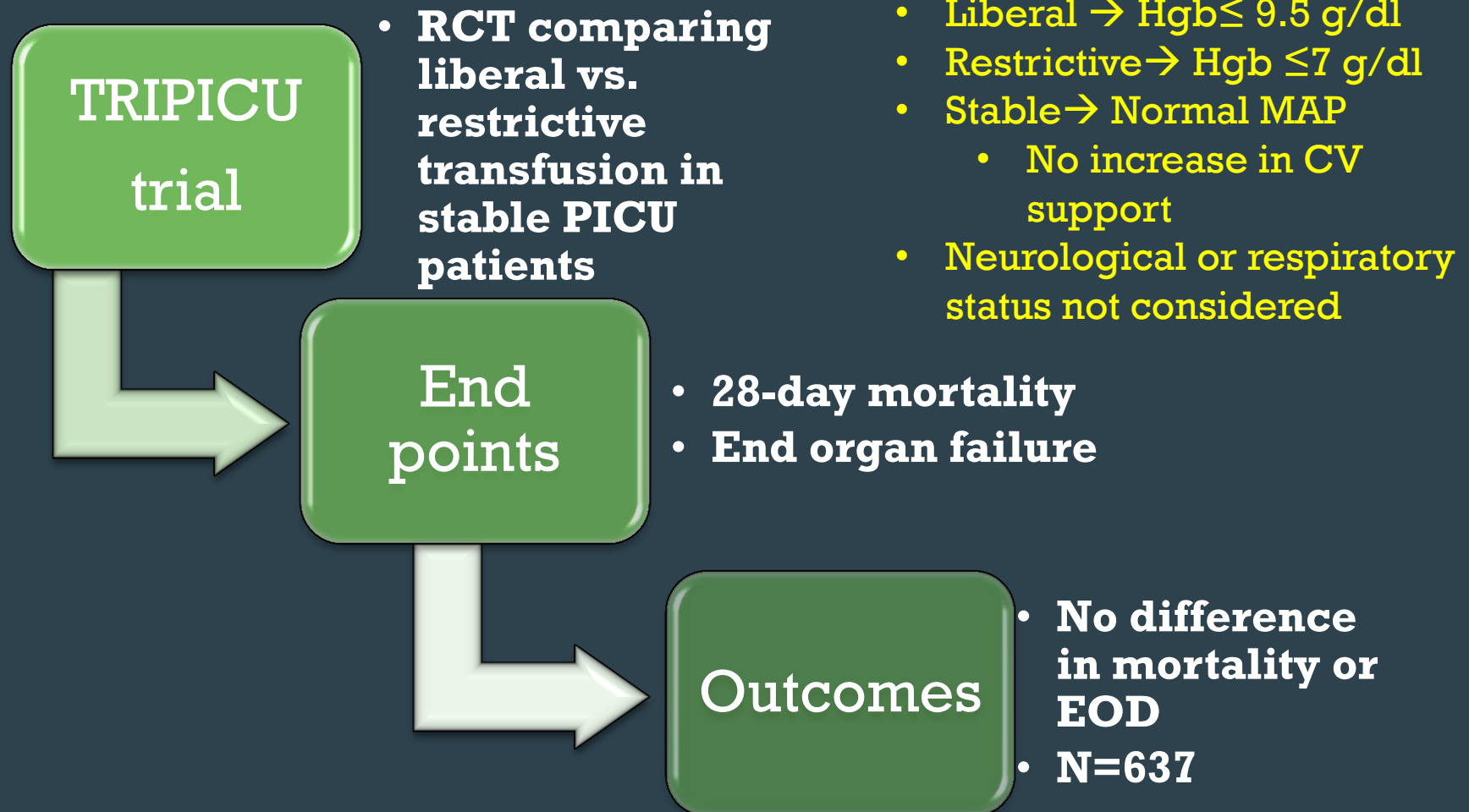
1. Age
2. Chronicity
3. Cause
4. Symptoms
5. Underlying disease

Trend over time

Historically
High Hgb
Thresholds (≥ 9
g/dl)

More
restrictive
transfusion

RBC transfusion-Clinical trial



Recommendations on RBC Transfusion in General Critically Ill Children Based on Hemoglobin and/or Physiologic Thresholds From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative

Allan Doctor, MD¹; Jill M. Cholette, MD²; Kenneth E. Remy, MD, MHSc¹; Andrew Argent, MD (Paediatrics), MBBCh³; Jeffrey L. Carson, MD⁴; Stacey L. Valentine, MD, MPH⁵; Scot T. Bateman, MD⁶; Jacques Lacroix, MD⁷; for the Pediatric Critical Care Transfusion and Anemia Expertise Initiative (TAXI), in collaboration with the Pediatric Critical Care Blood Research Network (BloodNet), and the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network

Good practice statements

- Clinical context of transfusion must be considered
- Hemoglobin should be checked prior to transfusion UNLESS active bleeding

Doctor, A., et al. "Recommendations on RBC Transfusion in General Critically Ill Children Based on Hemoglobin and/or Physiologic Thresholds From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative." *Pediatric critical care medicine: a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies* 19.9S Suppl 1 (2018): S98.

Current Consensus

- Hemoglobin ≤ 50 g/dl for stable patients
 - Transfusion recommended
 - High risk of mortality
- Hemoglobin 50-70 g/dl
 - Expert opinion and clinical context
- Hemoglobin ≥ 70 g/dl
 - Transfusion NOT recommended
 - UNLESS unstable cardiac patients/Patients on ECMO

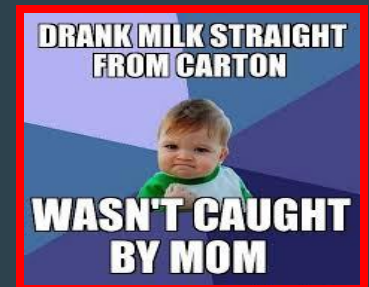
1. English M, Ahmed M, Ngando C, et al: Blood transfusion for severe anaemia in children in a Kenyan hospital. *Lancet* 2002; 359:494–495

2. Lackritz EM, Campbell CC, Ruebush TK 2nd, et al: Effect of blood transfusion on survival among children in a Kenyan hospital. *Lancet* 1992; 340:524–528



Answer 5

- A 3 year old **rambunctious** male is scheduled for a routine tonsillectomy 8 weeks from today. He **hops** into the clinic holding a **15 oz bottle of milk** in his hand. Hemoglobin today is 62 with an **MCV of 59**. Mother says he does not like to eat ANYTHING! What is your next step?
- a. Transfuse PRBCs 10ml/kg
 - b. Check iron indices and provide supplemental iron. Check CBC at 1 and 4 weeks**
 - c. Cancel surgery
 - d. Reschedule surgery



Pre-operative transfusion

- For elective procedures
 - Screen for anemia and iron deficiency
 - Screen for bleeding risks
 - Limit phlebotomy
 - Use surgical blood saving strategies (Cell saver)
 - Use antifibrinolytics for surgeries with a significant risk of bleeding
- Transfuse for hemoglobin ≤ 70 gm/dl
 - TRIPICU trial

Transfusion in congenital cardiac disease

- Extremely heterogeneous group
- Good practice recommendations
 - Optimization of oxygen delivery
 - Blood conservation during cardiac surgery
 - Perioperative blood management
 - IV iron
 - Cautious use of Erythropoietin
- RBC transfusion not recommended for $Hb \geq 90$ g/dl for stable patients

Transfusion thresholds in CHD

Myocardial infarction

No evidence for a threshold

Same rules apply as a stable critical patient

Unrepaired CHD

Hemoglobin 70-90 g/dl (TRIPICU Study)

Low quality evidence

Other considerations

Pre and post operative anemia management

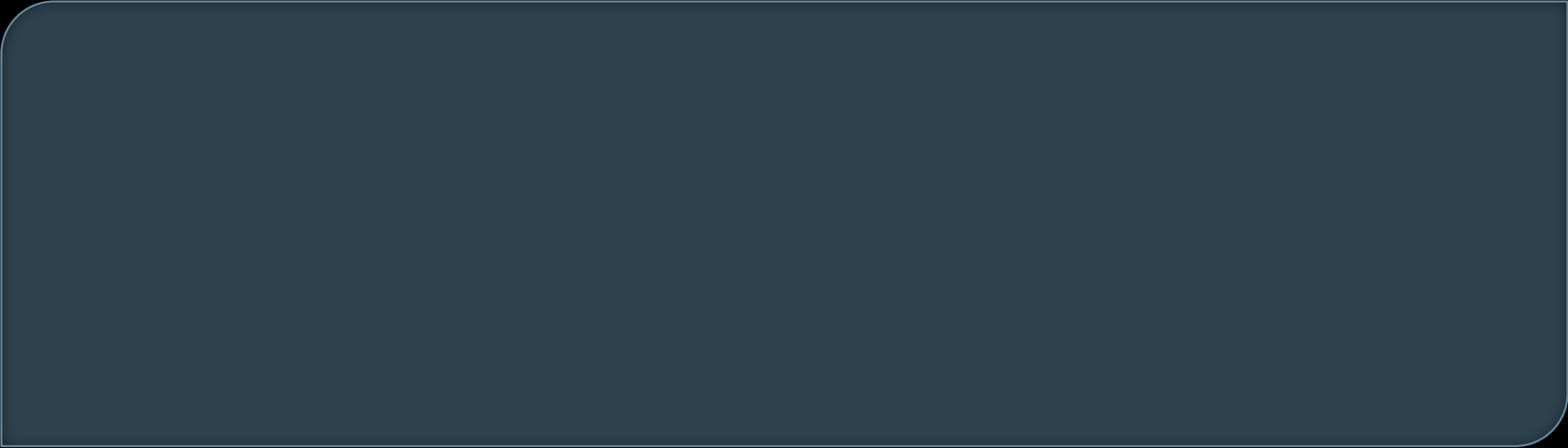
No effect of storage duration

There are no specific guidelines
for PRBC transfusion in patients
with neurologic or lung disease

Threshold for oncology patients is
based on adult data and TRIPICU
study $\leq 70\text{g/dl}$

Summary

- Use of hemoglobin alone
 - Not sufficient to make a transfusion decision
- Child with no active bleeding/Hemolysis
 - Transfusion indicated for hemoglobin ≤ 50 g/dL
 - Clinical context to determine transfusion between Hgb of 50-70g/dL
 - Not recommended over 70 g/dL
- Cardiac patients
 - Based on cardiac lesion, myocardial reserve and repaired versus non-repaired
- Effective blood management reduces transfusion needs



RBC transfusion in premature infants

Question 6

- Which of the following are **NOT** indications for PRBC transfusion in a premature neonate in NICU
 - a. Acute blood loss >20% of blood volume
 - b. Mechanical ventilation with hemoglobin of 80g/dl on day 3 of life
 - c. HFNC (30%FiO₂) and apneic episodes with hemoglobin of 80 on day 10 of life
 - d. On room air with PO feeds on day 20 of life with hemoglobin of 80 g/dl

Indications and complications

- Improves oxygen carrying capacity
 - Used frequently in extremely LBW infants
- Associated with multiple prematurity complications
 - IVH, NEC and ROP
- More prone to side effects
 - TACO, TRALI

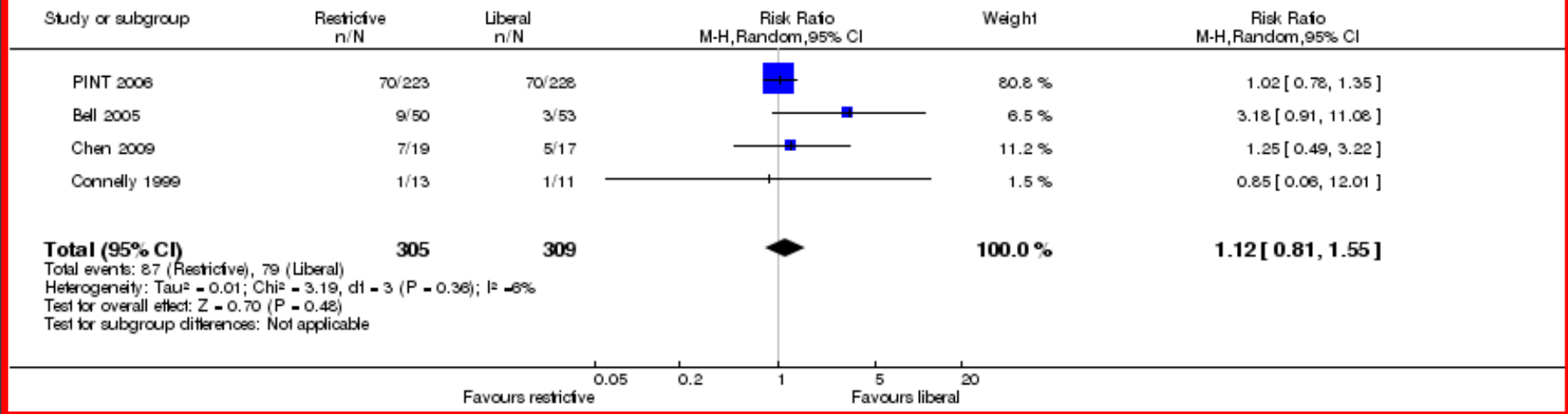
Lieberman L, Petraszko T, Yi Q, et al.: Transfusion-related lung injury in children: a case series and review of the literature. *Transfusion*. 2014; 54(1): 57–64.

Stainsby D, Jones H, Wells AW, et al.: Adverse outcomes of blood transfusion in children: analysis of UK reports to the serious hazards of transfusion scheme 1996–2005. *Br J Haematol*. 2008; 141(1): 73–9.

Current Evidence

● Cochrane review with 4 RCT (N=637)

Review: Low versus high haemoglobin concentration threshold for blood transfusion for preventing morbidity and mortality in very low birth weight infants
 Comparison: 1 Transfusion at a restrictive vs a liberal haemoglobin threshold
 Outcome: 8 Death or severe brain injury by first hospital discharge



Hgb 110-80g/dl

Hgb 135-110 g/dl

Measured at hosp. discharge and 18-21 months

Endpoints

- Death
- Death or severe morbidity
- Death or severe neurologic impairment

Whyte, Robin, and Haresh Kirpalani. "Low versus high haemoglobin concentration threshold for blood transfusion for preventing morbidity and mortality in very low birth weight infants." *Cochrane Database of Systematic Reviews* 11 (2011).

Recommendations-CPS

First week

- Resp.support:
115 g/dl
- No support:
100 g/dl

Second week

- Resp. support:
100g/dl
- No support:
85 g/dl

Third week

- Resp. support:
85g/dl
- No support:
75g/dl

- Recommendations based on the PINT trial (N = 437 premature infants)
- Long term neurodevelopmental outcomes were not considered

Other recommendations

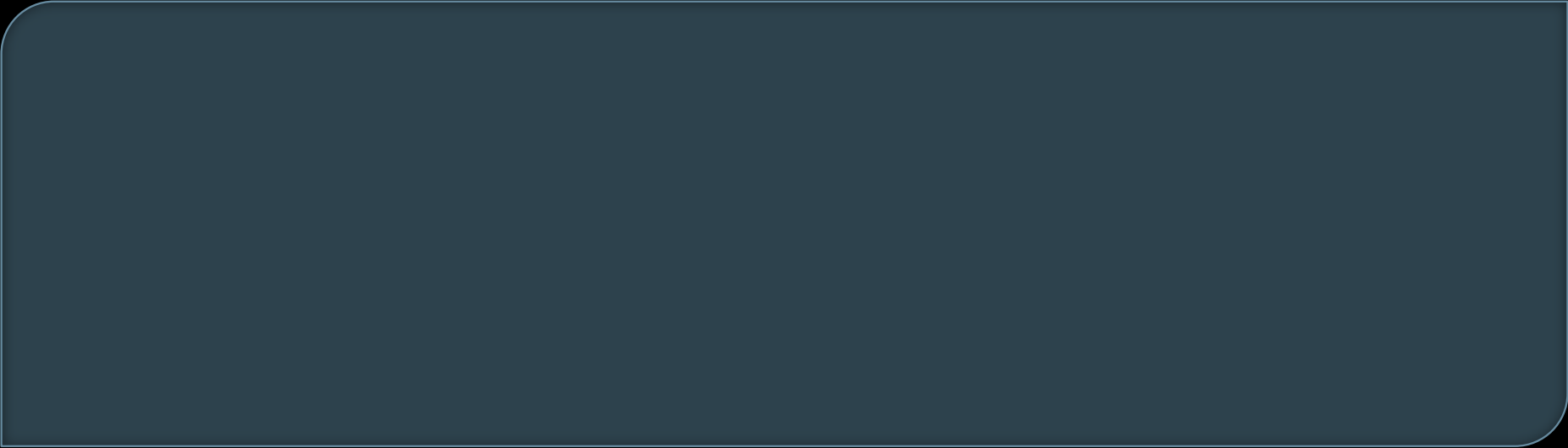
- Delayed cord clamping
 - Reduced transfusion need in premature infants
 - Recommended for stable preterm infant
- Use of erythropoietin
 - Increased risk of ROP
 - Modest reduction in transfusion requirement
 - Consider where transfusion is denied

Other recommendations

- Volume of transfusion
 - Standard 15 ml/kg
- Storage age of blood
 - Consider fresh RBC (D0-5) for large volume or exchange transfusion
 - Monitor for hypocalcemia and hyperkalemia
- Use of blood warmers for large volume transfusions

Summary

- Multiple limitations in formulating evidence for transfusion in premature infants
- Thresholds are based on PINT trial
 - Vary based on gestational age and resp. support
- Important to minimize blood loss
 - Delayed cord clamping in stable preemies
 - Limiting phlebotomy
 - Limit donor exposure by large volume transfusion (weak evidence)



Transfusion of other blood products

Transfusion of platelets

- Lack of high quality pediatric studies
- Recommendations are based on adult literature

Question 7

- A 5 year old previously healthy girl presented to ER with bruises and petechie on torso. She has no other symptoms. CBC shows normal WBC and hemoglobin with platelet count <10 . Coagulation studies are normal. What are the next steps?
- a. Transfuse 1 unit of platelet
- b. Consider IVIG/Steroids or close follow up
- c. Admit and perform a bone marrow biopsy
- d. Discharge home with follow up by family doctor in 1 month

Platelet transfusion thresholds

Table III. Suggested thresholds of platelet counts for platelet transfusion in children.

Platelet count ($\times 10^9/l$)	Clinical situation to trigger platelet transfusion
<10	Irrespective of signs of haemorrhage (excluding ITP, TTP/HUS, HIT)
<20	Severe mucositis Sepsis Laboratory evidence of DIC in the absence of bleeding* Anticoagulant therapy Risk of bleeding due to a local tumour infiltration Insertion of a non-tunnelled central venous line
<40	Prior to lumbar puncture†
<50	Moderate haemorrhage (e.g. gastrointestinal bleeding) including bleeding in association with DIC Surgery, unless minor (except at critical sites) • including tunnelled central venous line insertion
<75–100	Major haemorrhage or significant post-operative bleeding (e.g. post cardiac surgery) Surgery at critical sites: central nervous system including eyes

Question 8

- You receive an order in blood bank to transfuse 1 unit of platelets for a neonate with a platelet count of 24. Which of the following is an appropriate indication for platelet transfusion?
- a. Full term neonate with FNAIT and family history of ICH
- b. Premature infant with no bleeding (H/O placental insufficiency)
- c. Full term neonate born to a mother with ITP (no bleeding)
- d. Full term neonate with FNAIT and no family history or bleeding

Platelet transfusion-Neonates

- Thrombocytopenia in neonates
 - Related to GA
 - Number alone is not a predictor of bleeding risk
- Platelets $\geq 50,000$
 - Well tolerated in most cases

New, Helen V., et al. "Guidelines on transfusion for fetuses, neonates and older children." *British journal of haematology* 175.5 (2016): 784-828.

Andrew M, Vegh P, Caco C, et al.: **A randomized, controlled trial of platelet transfusions in thrombocytopenic premature infants.** *J Pediatr.* 1993; **123**(2):285-91.

Platelet transfusion thresholds

Table II. Suggested thresholds of platelet count for neonatal platelet transfusion.

Platelet count ($\times 10^9/l$)	Indication for platelet transfusion
<25	Neonates with no bleeding (including neonates with NAIT if no bleeding and no family history of ICH)
<50	Neonates with bleeding, current coagulopathy, before surgery, or infants with NAIT if previously affected sibling with ICH
<100	Neonates with major bleeding or requiring major surgery (e.g. neurosurgery)

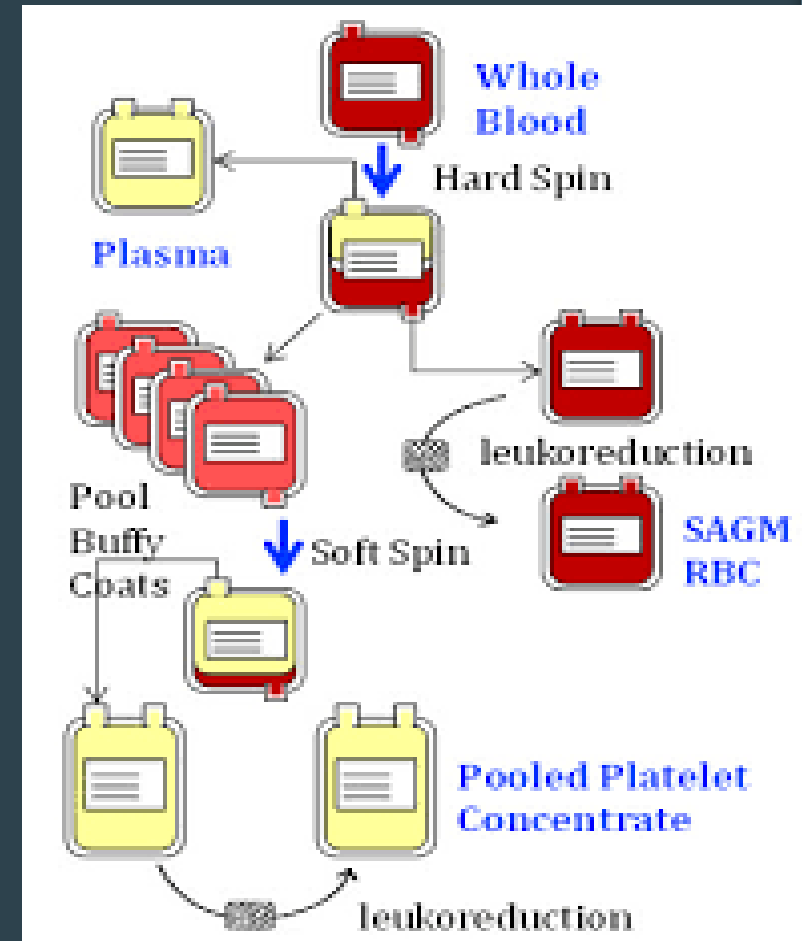
NAIT, neonatal alloimmune thrombocytopenia; ICH, intracranial

Andrew M, Vegh P, Caco C, et al.: **A randomized, controlled trial of platelet transfusions in thrombocytopenic premature infants.** *J Pediatr.* 1993; 123(2):285–91.

New, Helen V., et al. "Guidelines on transfusion for fetuses, neonates and older children." *British journal of haematology* 175.5 (2012): 724–32.

SDP versus pooled platelets

- Absolute indications for single donor platelets
 - IgA deficiency
 - HLA/HPa alloimmunization
- SDP platelets
 - Small volume transfusions
 - Marrow failure states
- Pooled platelets
 - ABO incompatibility



Transfusion of FFP

- Indicated in massive trauma or operative bleeding
- Should not be used to correct minor PT/PTT prolongation in non-bleeding patient
 - Even before surgery
- Associated with risks
 - Allergic reactions
 - TRALI/TACO
 - Risk of thrombosis

FFP transfusion

Table 8: Guidelines for the transfusion of plasma. Reprinted with permission from *Paediatric Transfusion: A Physician's Handbook*, 3rd edition.¹²

1. Replacement therapy in a bleeding patient or one about to undergo invasive procedure
2. When specific factor concentrates are not available, including but not limited to Factors II, VII, X, and XI, protein C or S
3. PT/INR >1.5 x mid-range of age-related normal value and/or PTT >1.5 x top of age-related normal value in a bleeding patient or one about to undergo invasive procedure
4. During therapeutic plasma exchange when Plasma is indicated
5. Reversal of warfarin in an emergency situation, such as before an invasive procedure with active bleeding (consider use of prothombin complex concentrate if available)

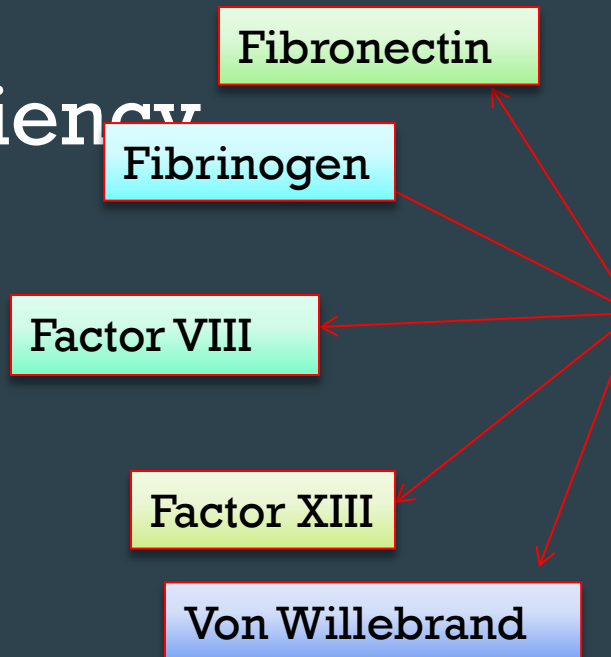
Transfusion of Cryoprecipitate

General indications

- Bleeding patient with fibrinogen <1 g/dl
- In DIC maintain fibrinogen between 1-1.5 g/dl

Fibrinogen Deficiency

- Inherited
- Acquired



Dose of blood products

	Typical Dose	Expected increment	Compatibility	Time for transfusion
Red Blood Cells	10-15ml/kg 20ml/kg in neonates*	15ml/kg = 20-30g/dl	ABO and RH compatible Cross match needed	2-4 hours (4 hours MAX.)
Platelets	10-15ml/kg	15ml/kg = 30-50 x 10 ⁹	Recipient ABO type ABO and RH compatible** If RH incompatible RIG***	60 min typical (4 hours MAX.)
Plasma	10-15ml/kg	Factor activity increased ~15-20%	Recipient ABO type ABO compatible Not RH	30-120 min. (4 hours MAX)
Cryoprecipitate	1-2 Units/Kg 5-10ml/kg in neonates	1 dose = increase fibrinogen ~0.5g/dl	Confirm blood group needed	15-30 min.

Modified from Dr. Prokopchuk-Guak slides

*High dose of RBC may be considered for neonatal transfusion to reduce donor exposure

**ABO and RH compatibility not always possible

***RHIG used for RH negative women of childbearing age receiving RH positive platelets.

Pre transfusion testing

	Neonate	Child (4 month-18 years)
Forward type (ABO)	Yes	Yes
Reverse type (plasma Anti-A and B)	No	Yes
RH type	Yes	Yes
Antibody Screen	Yes	Yes
Cross-Match	AB-Screen negative E-Crossmatch Group O, RH compatible RBC AB-screen positive Gel crossmatch RBC	AB-screen negative E-Crossmatch ABO and RH compatible RBC AB-screen positive Gel Crossmatch RBC

1. Fetal red cell antigens appear around 5-6 weeks of gestational age
2. Anti A and Anti-B antibodies do not appear in plasma till ~9-12 months of life
3. Sample is valid for 4 months in a neonate and for 96 hours in a child

Areas for future research-Neonates

- Age specific definition of anemia in neonates
- Impact of RBC transfusions on long term neurodevelopmental outcomes
- Effect of red cell storage lesion

Areas for future research-Pediatrics

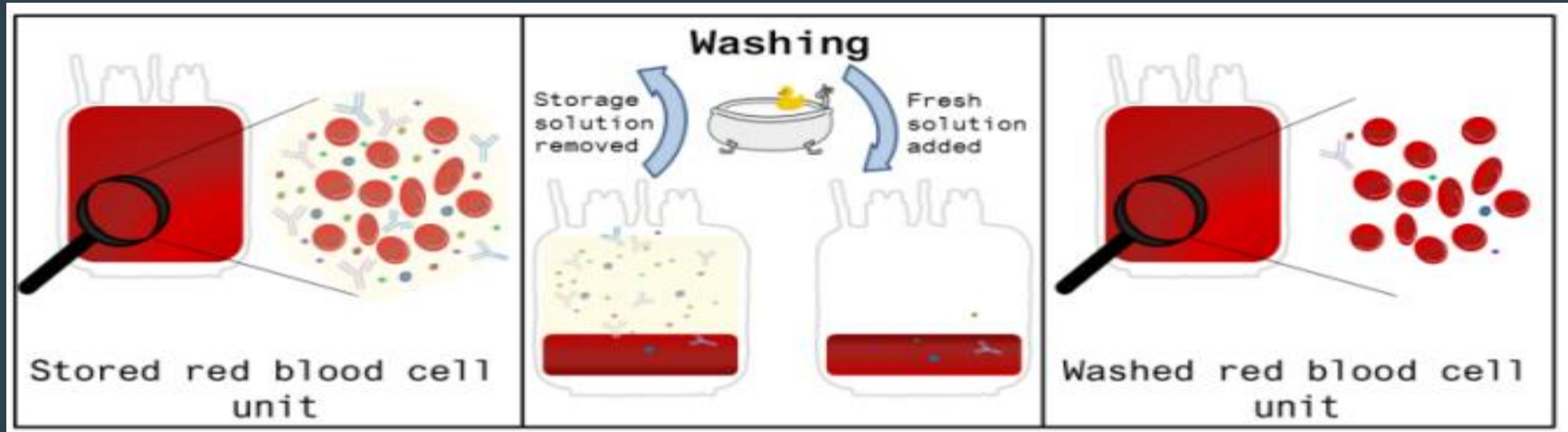
- Biomarkers to indicate physiologic tolerance to anemia
- Risks vs. benefits of transfusion b/w hemoglobin thresholds 50-70g/dl
- Optimal transfusion threshold
 - Patients with respiratory or neurologic issues
 - Patients undergoing surgery



**KEEP
CALM
AND
RESEARCH
ON**



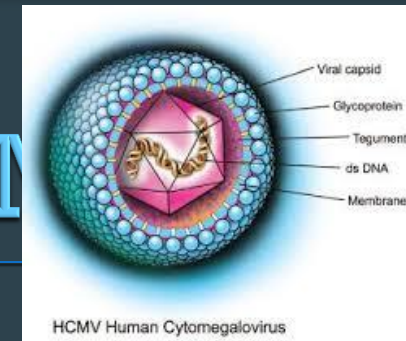
Washing of cellular products



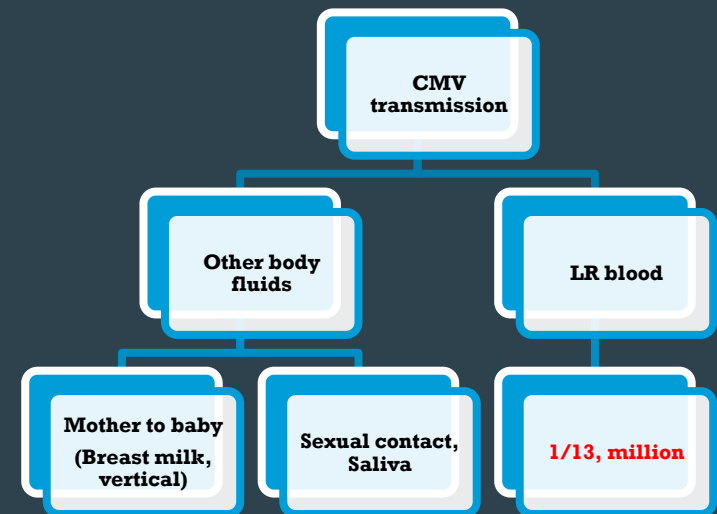
Indications in pediatrics

- Patients with history of anaphylactic/anaphylactoid reactions
- IgA-deficiency
- Neonates undergoing exchange transfusion
- FNAIT → Washed platelets from mother

CMV virus



- CMV virus
 - Herpes virus family
- High risk groups
 - Antenatal exposure
 - Immunosuppressed patients
- Immunocompetent adults
 - Flu like illness



CMV exposure reduction

- CMV safe (leukoreduced) and CMV IgG seronegative products equivalent
 - except for Intrauterine transfusion
- Stop provision of CMV seronegative units issued to hospital facilities
- Keep a small boutique inventory of dually tested (seronegative and NAT) CMV negative blood components for the sole purpose of IUT.



Special populations

IUT--Neonate

Transfusion of RBC for fetal anemia

Hemolytic disease

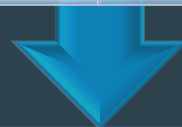
Alpha thalassemia



Modifications of red blood cells

O, rh negative, S negative

Irradiated, CMV negative, washed



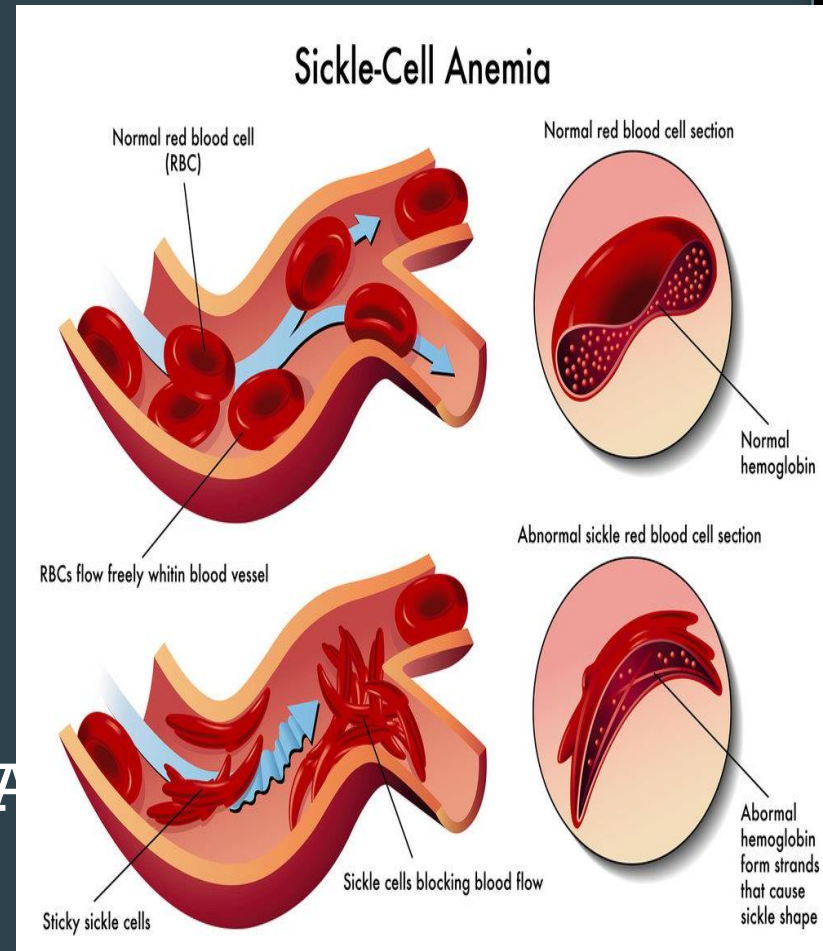
Site and outcomes

Intraperitoneal or UV

>90% survival (Depends on severity)

Sickle Cell disease

- Hemoglobinopathy associated with anemia and vaso occlusive crisis
 - Short and long term end organ damage
- Transfusion benefits
 - Increased O₂ delivery
 - Suppresses HbS production
 - Reduces HbS by adding HbA

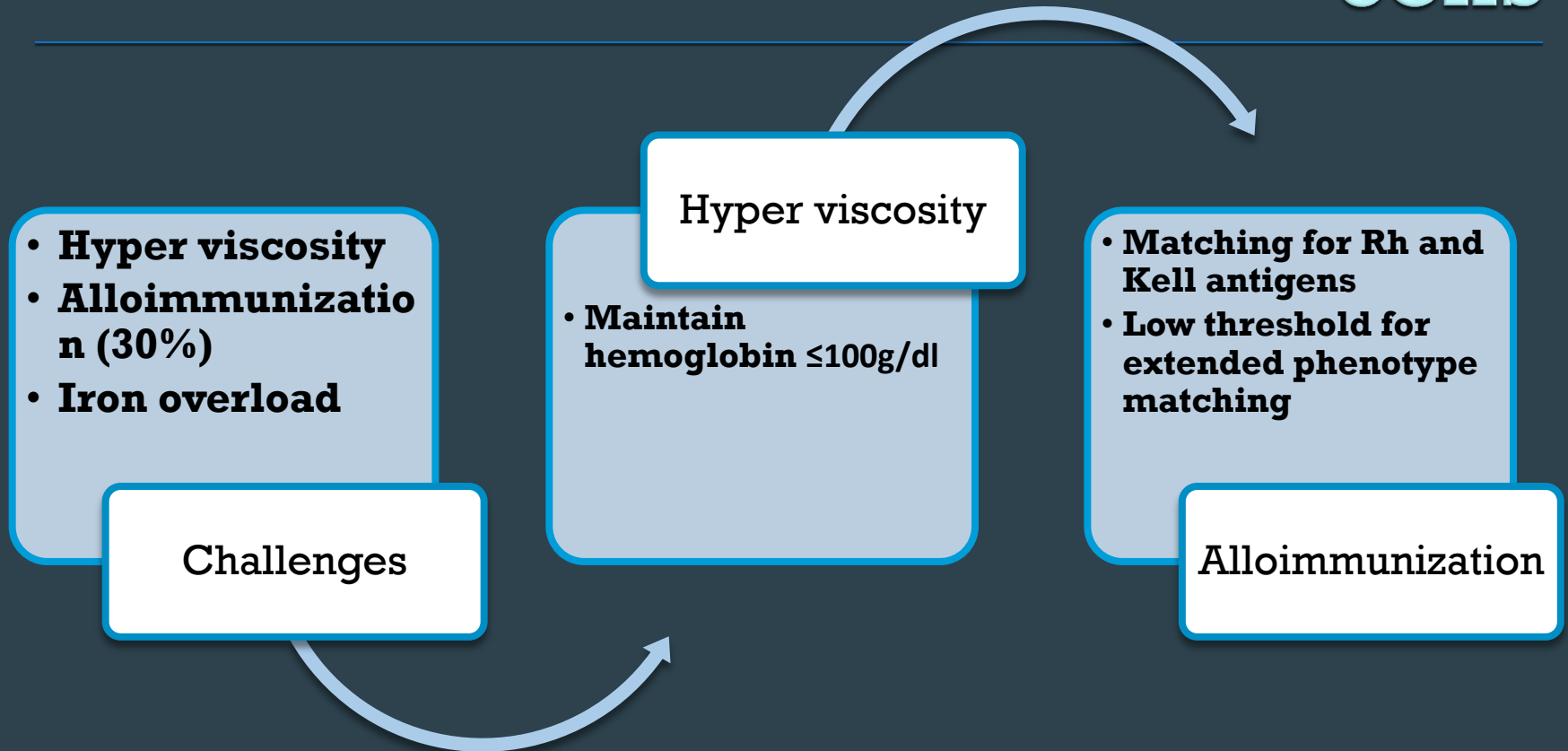


Transfusion indications in sickle cell cell

- Exchange transfusion
 - Acute stroke
 - Acute Chest syndrome
 - Multi-Organ Failure
- Simple transfusion
 - Aplastic crisis
 - Splenic sequestration
 - Pre-operative
 - Anesthesia >30minutes
 - Anemia with VOC



Caveats and modification of red cells



- RBC storage lesion
 - No consensus.
 - Most centers use RBC <15D for exchange

Other considerations

- Use of HU to prevent transfusions
- Avoid transfusions for simple pain crisis
- Avoid transfusions for simple anemia
- Low threshold for introducing iron chelation

Thalassemia

- Red cell transfusion in thalassemia
 - Reduces abnormal erythropoiesis
 - Increases Oxygen delivery to tissues
 - Promotes growth
- Chronic transfusion therapy
 - Thalassemia major
 - Maintain Hb > 90-100g/dl to suppress abnormal erythropoiesis

Risks

Transfusion Risks

```
graph TD; A[Transfusion Risks] --> B[Alloimmunization]; A --> C[Iron overload]; A --> D[Transfusion reactions];
```

Alloimmunization

Iron overload

Transfusion
reactions

Exchange transfusion-neonate

● Benefits

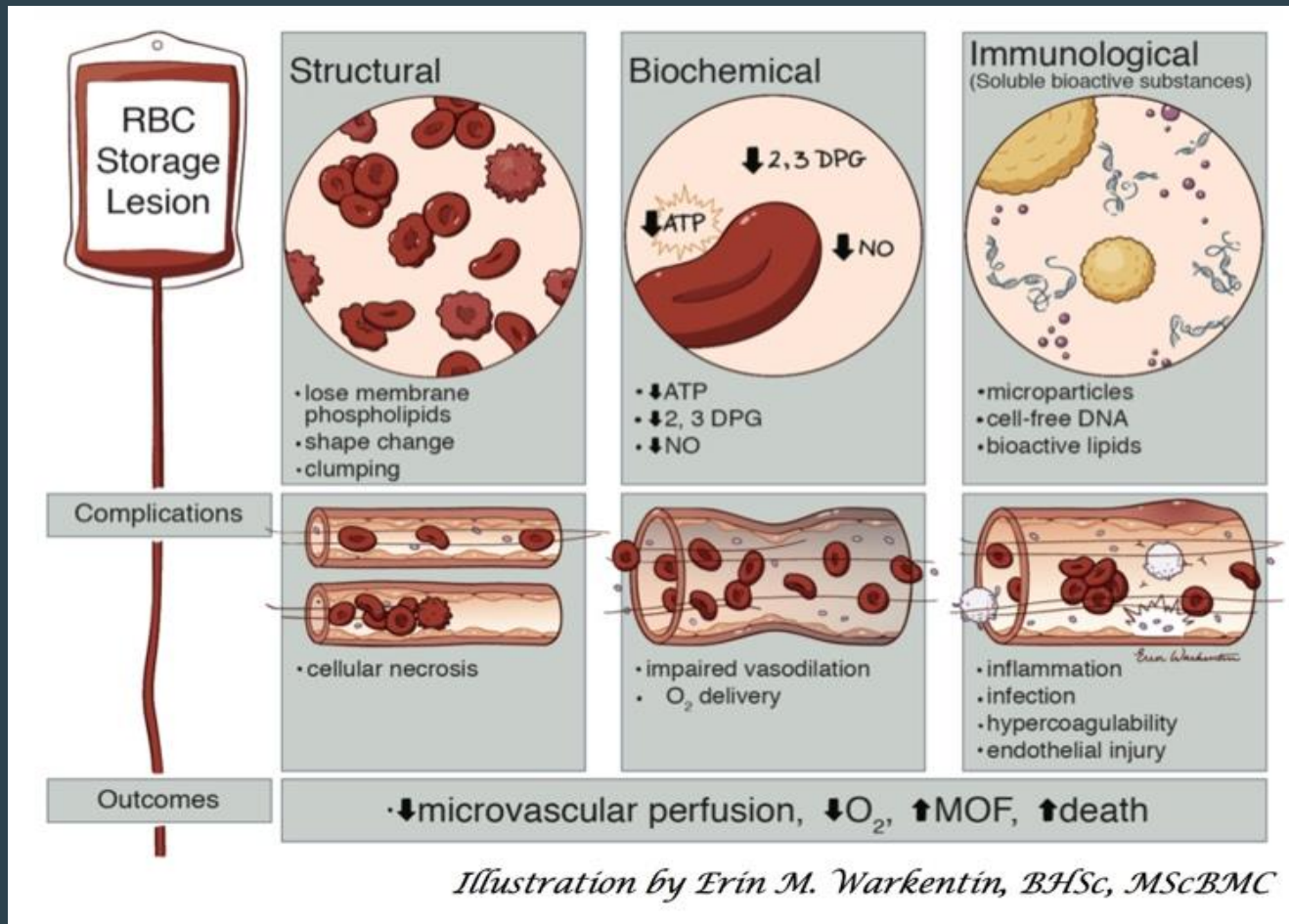
- Removed bilirubin (prevents CNS damage)
- Removes maternal antibodies
- Treats anemia

● Special modifications

- Irradiation
- Washing (to prevent hyperkalemia)
- O negative, antigen negative RBC, S negative reconstituted with AB plasma

Blood product modifications

RBC storage lesion



Age of RBC unit

TOTAL trial

N= 260 (age 6-60 months)

New (age 1-10 D) vs. old (25-35 D) red cell units

No difference in lactate levels, adverse events and 30 day survival

ARIPI trial

N=377 (ELBW premature infants)

New (0-7 D) vs. old (7-14D) RBC units

No difference in rates of infection and organ dysfunction

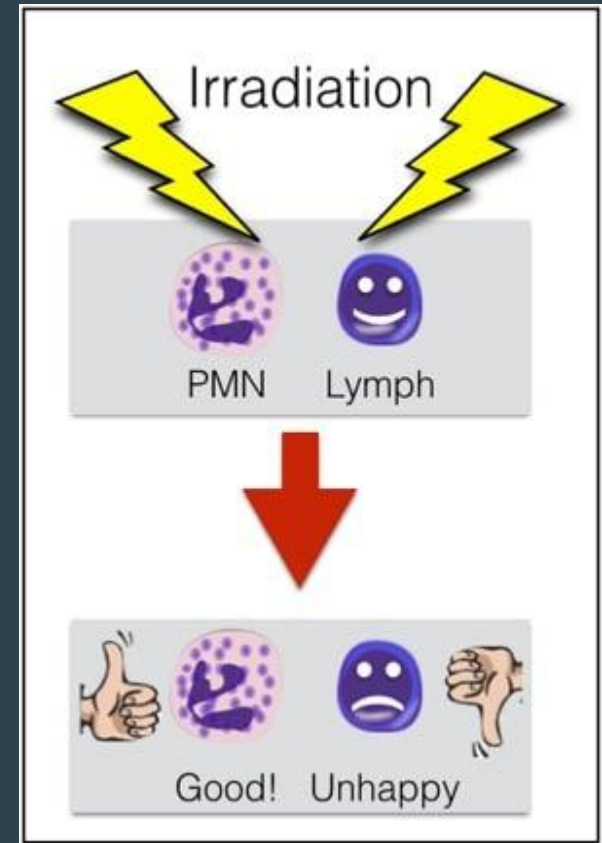
- ARIPI trial → Issues with generalizability
- TOTAL trial → Different patient population with baseline hemolysis
- ABC PICU trial upcoming

Fergusson DA, Hébert P, Hogan DL, et al.: Effect of fresh red blood cell transfusions on clinical outcomes in premature, very low-birth-weight infants: the ARIPI randomized trial. JAMA. 2012; 308(14): 1443–51.

Dhabangi A, Ainomugisha B, Cserti-Gazdewich C, et al.: Effect of Transfusion of Red Blood Cells With Longer vs Shorter Storage

Irradiation

- Damage to viable T-lymphocytes in blood product by Irradiation
 - Prevention of TA-GVHD in individuals at risk
- Effects on PRBC unit
 - Hemolysis and Hyperkalemia
 - Shelf life reduced (28D)
 - Additional wash
 - if irradiated >24 hours before transfusion
 - Large volume or IUT



Indications



Special Requirements for Blood Components

Transfusion Medicine

Special Requirement	Eligible Patients
Irradiated Cellular Blood Components	<ul style="list-style-type: none">• Low birth weight premature newborns (<1200 g) until 4 months of age• History of intrauterine transfusion, until 6 months after the initial expected delivery date (40 weeks gestational age)• Neonatal exchange transfusion• Directed donations• HLA matched components• Allogeneic stem cell/bone marrow transplant recipients (from start of conditioning chemotherapy, for life after transplant)• Autologous stem cell/bone marrow transplant recipients (from 7 days before the start of stem cell mobilization, until 6 months post-transplant)• Allogeneic stem cell donors (7 days prior to collection and during the collection process only)• Congenital T-cell immune deficiency (DiGeorge syndrome, SCID)• Hodgkin's Lymphoma, for life• Patients receiving or who have received the following (for life, from the time of drug initiation):<ul style="list-style-type: none">• Anti-thymocyte globulin (ATG)• Alemtuzumab (Campath)• Bendamustine• Cladribine• Clofarabine• Deoxycoformicin• Fludarabine• Pentostatin

Summary

- Age of RBC product
 - Fresh units (1-14D) only indicated for Neonatal exchange transfusion
- Irradiation
 - T cell deficiency, ELBW, HLA matched/Directed donations, anti T cell medications

Refusal of blood products

- Can happen due to religious reasons
 - Jehovah's witnesses
- Optimize blood management
 - Limit phlebotomy
 - Iron and Erythropoietin
- Advance preparation
 - Review what products can or cannot be used