Neonatal & Pediatric Transfusion

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DISCLOSURE

- No commercial product or services conflicts of interest to declare

TRANSFUSION KNOWLEDGE QUESTIONS PRE

LEARNING OBJECTIVES

- In this session, the participant will learn some of the differences in transfusion practice between neonates/pediatrics and adults, including:
  - The indications for red cells transfusion for pediatric and neonatal patients
  - Pre-transfusion testing for neonates
  - The selection of appropriate red cells for pediatric and neonatal patients
  - Blood administration practices that are different from adult practice

CHILDREN ARE NOT LITTLE ADULTS

Blood transfusion practice for neonates and children has a lot of commonalities to adult practices

BUT

there are some important differences / special circumstances that are unique to these groups.

CASE

Baby:

- Male, 29w2d GA, 30w1d PMA. Birth weight of 1.19 kg
- Initial hemoglobin at DOL 1 was 164 g/L. DOL 6 decreased to 100 g/L.
- Respiratory support required. Signs consistent with RDS.
- Evaluation for sepsis – cultures drawn and antibiotics started.
- Mild hyperbilirubinemia requiring phototherapy.

Mother:

- 30 year old, healthy, Gravida 1
- Blood Group: O Positive
- Antibody screen: negative

WHAT IS UNIQUE FOR NEONATES & PEDIATRICS

HEMOGLOBIN LEVELS - BIRTH TO ADOLESCENCE

Normal hemoglobin levels change during early development until adolescence




Newborn	3 months	6 mth – 2 yrs	6 -12 yrs	12 – 18 yrs
~ 165 g/L	~ 115 g/L	~ 125 g/L	~ 135 g/L	F ~ 140 g/L M ~ 145 g/L

Clinical Guide to Transfusion, Canadian Blood Services

HEMOGLOBIN LEVELS – NEONATES & PRE-TERM

Newborn	3 months
~ 165 g/L	~ 115 g/L

Physiologic or early anemia of infancy

Age	Pre- Term	
	1.0 – 1.5 kg	1.5 – 2.0 kg
2 weeks	163 g/L	148 g/L
1 month	109 g/L	115 g/L
2 months	88 g/L	94 g/L
3 months	98 g/L	102 g/L

Anemia of prematurity

Higher risk for clinically significant anemia

BLOOD VOLUMES

Blood volumes change during early development into adolescence and adulthood




Pre-term	Term Newborn	Infant (> 3 months)	Child	Adolescent / Adult
~ 100 ml/kg	~ 85 - 90 ml/kg	~ 75 - 80 ml/kg	~ 70 - 75 ml/kg	~ 65 – 70 ml/kg

Blood volume calculator, MDApp.

BLOOD LOSSES IN NEONATES

Hemorrhage

Hemolysis

Phlebotomy (Iatrogenic Blood Loss)

CBC & Differential

Type & Screen

INR / PTT

Glucose

Blood gas

Sodium

Potassium

Chloride

Magnesium

Creatinine

Ionized calcium

Magnesium

Phosphate

Bilirubin – conjugated/unconjugated

Urea

Blood cultures

Clinical Guide to Transfusion, Canadian Blood Services;
Images: www.BD.com

INDICATIONS FOR RED CELL TRANSFUSION - NEONATES

General Indications for neonates:
Acute blood loss of >10% blood volume
Hemoglobin less than 80 g/L in a stable newborn with symptoms of anemia
Hemoglobin less than 120 g/L in an infant with respiratory distress syndrome or congenital heart disease

Clinical Guide to Transfusion, Canadian Blood Services

INDICATIONS FOR RED CELL TRANSFUSION – PRE-TERM

Suggested transfusion thresholds for pre-terms with anemia of prematurity:

Postnatal age	Hemoglobin	
	With respiratory support*	No Respiratory support
0 to 7 days	115 g/L	100 g/L
8 to 14 days	100 g/L	85 g/L
> 14 days	85 g/L	75 g/L

*Respiratory support is defined as an inspired oxygen requirement in excess of 25% or the need for mechanical increase in airway pressure

Clinical Guide to Transfusion, Canadian Blood Services;
Red Blood Cell Transfusion in Newborn Infants Position Statement, Canadian Paediatric Society

INDICATIONS FOR RED CELL TRANSFUSION – PEDIATRICS

General Indications for pediatrics:
Acute blood loss of >15% blood volume
Hemoglobin < 70 g/L with symptoms of anemia
Significant preoperative anemia when other corrective therapy is not available
Hemoglobin <130 g/L on extracorporeal membrane oxygenation
Chronic transfusion programs for disorders of red blood cell production

Clinical Guide to Transfusion, Canadian Blood Services

Case:

- VLBW, pre-term baby
- 6 days old
- Low hemoglobin (100 g/L)
- On respiratory support
- Signs of respiratory distress syndrome
- Blood loss due to phlebotomy losses

Do you think this baby could benefit from a red cell transfusion?

A. Yes

B. No

C. Unsure

TYPES OF RED CELL TRANSFUSIONS

Massive Transfusion / Large Volume

Massive: Greater than one blood volume in 24 hours.
Large Volume: > 20 ml/kg

Example - Exchange Transfusion
- Marked hyperbilirubinemia
- Quickly lowers the levels of bilirubin that can cause neurological damage.

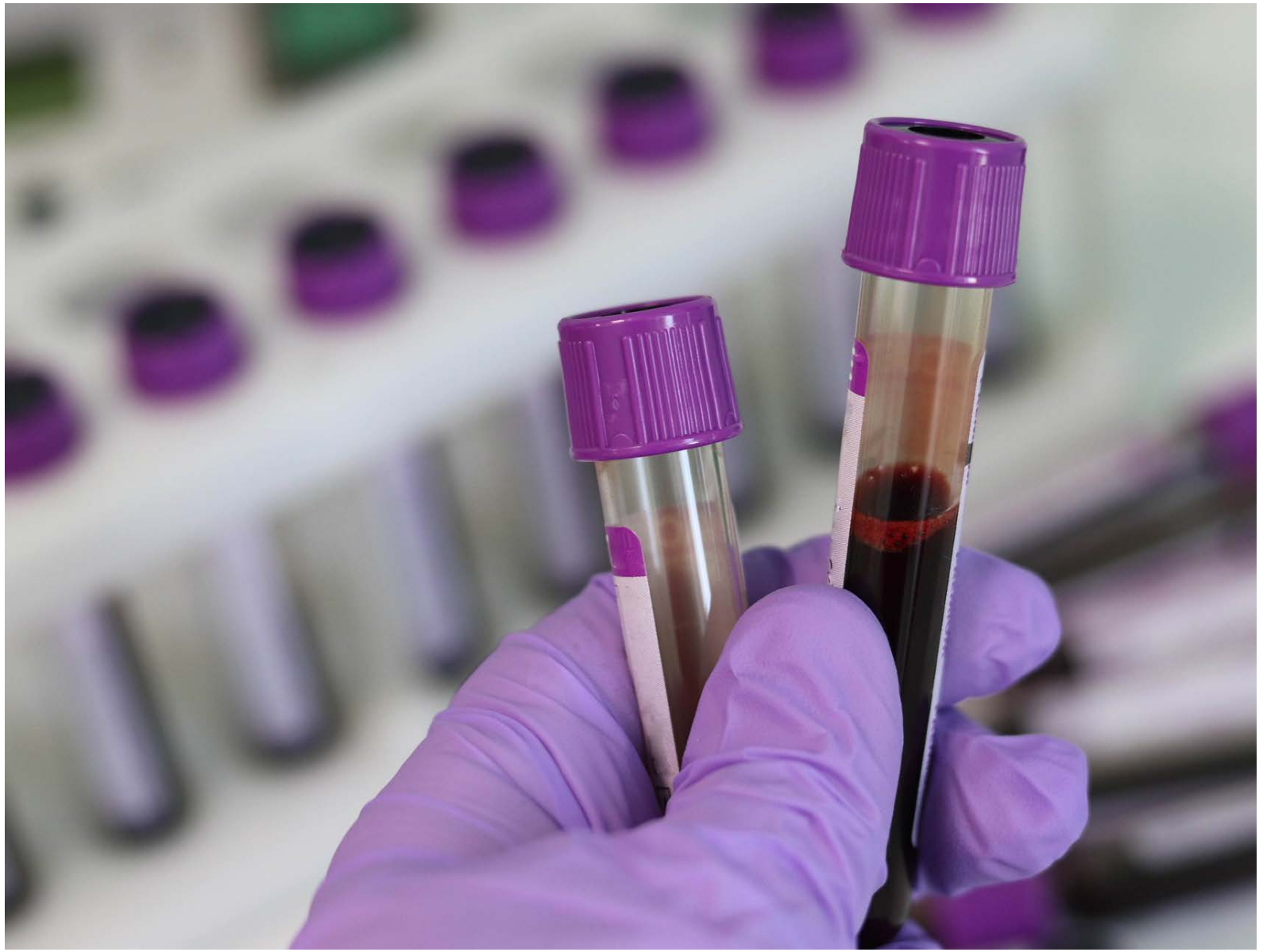
Small Volume ("Top-Up")

10-20 ml/kg dose to replace blood losses or increase hemoglobin (neonates & pediatrics)

A dose of 10 ml/kg should increase hemoglobin by ~10 g/L

Most common type of transfusion for pre-term neonates

Clinical Guide to Transfusion, Canadian Blood Services



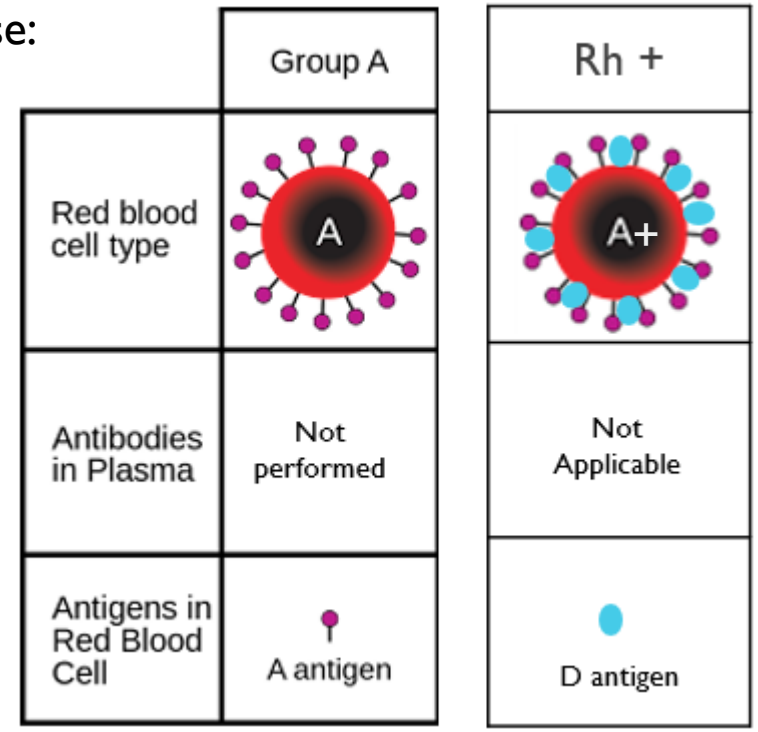
PRE-TRANSFUSION TESTING

FOR NEONATES < 4 MONTHS

ABO AND Rh(D)

- Red cell typing only for ABO/Rh (forward grouping)
- Plasma antibody (reverse grouping) – not performed because baby is not making ABO antibodies.
- If transfusion required/likely - blood group verified with second sample

Case:



Case:

= A Positive (or A+)

Standards for Hospital Transfusion Services. Canadian Society for Transfusion Medicine
Image: www.LaboratoryTests.org

ANTIBODY SCREEN

- Antibody Screen - to detect unexpected red cell antibodies.
- Maternal antibodies cross the placenta from the second trimester onwards.
- Neonate not making own red cells antibodies during first 4 months of age.
- Antibody screen represents the maternal antibody status rather than the neonate antibody status.
  - Can use neonate's or mother's specimen as all antibodies present will be maternal in origin.

Case:

Antibody Screen = Negative

Standards for Hospital Transfusion Services. Canadian Society for Transfusion Medicine

CROSSMATCH

- Done to ensure red cell unit is compatible with recipient.
- If the mother had a clinically significant red cell antibody, the neonate must be transfused with red cells that lack the antigen to which the antibody is directed.
- A full crossmatch would be performed until the antibody disappears from the neonate's circulation.

Case:

Antibody screen = negative

Full crossmatch not necessary

Standards for Hospital Transfusion Services. Canadian Society for Transfusion Medicine

TYPE & SCREEN EXPIRY

Initial Antibody Screen = Negative

Type & Screen sample is valid until baby reaches **4 months of age**

(during same admission, regardless of number of transfusions they had)

Standards for Hospital Transfusion Services. Canadian Society for Transfusion Medicine

BLOOD PRODUCT SELECTION

Case:

- Baby is A Positive
- Mom is O Positive

What ABO/Rh group of red cells should the baby receive?

A. O Positive
B. O Negative
C. A Positive
D. A Negative

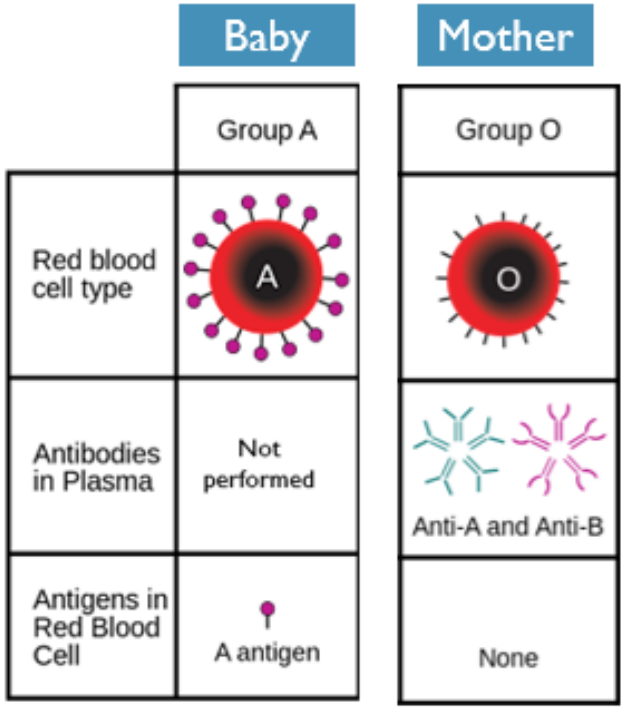
WHAT ABO/Rh TO GIVE?

ABO

- Needs to be compatible with neonate & mother - Can give group O
- To give group specific: Need to test neonate's plasma to make sure there is no maternal IgG ABO antibodies

Rh positive versus Rh negative

- Give Rh specific unless there is anti-D present.
- Do not routinely give Rh negative to Rh positive recipients.



Standards for Hospital Transfusion Services. Canadian Society for Transfusion Medicine
Image: www.LaboratoryTests.org

SELECTION OF RED CELLS – AGE OF RED CELL UNIT

- Red cell units of any age can be used for small volume transfusions in neonates.
- Fresher units should be used for large volume transfusions (> 20 ml/kg) due to potassium content in stored blood.

- Dedicated units for VLBW and ELBW neonates:
  - Fresh red blood cell unit is assigned to a specific neonate
  - Aliquots taken from unit up to the expiry date for small-volume red blood cell transfusions (multiple satellite packs or via sterile connection device).
  - Benefit: Decreased donor exposures for neonates expected to require multiple small volume transfusions.

Clinical Guide to Transfusion, Canadian Blood Services
Image: www.eugenics-myamar.com

IRRADIATION TO PREVENT TA-GVHD

Transfusion Associated Graft Versus Host Disease (TA-GVHD):

- Transfusion of cellular components containing viable T-lymphocytes into a recipient whose immune system is not capable of eliminating them.
- If donor lymphocytes are not eliminated, they proliferate and attack recipient tissue.
- High mortality rate – over 90%
- Prevention is key:
  - **Leukoreduction** – reduces white cell concentration in blood product, but does not eliminate all lymphocytes
  - **Irradiation** – Inflicts irreparable DNA damage to the lymphocytes and prevents them from replicating and therefore causing TA-GVHD

INDICATIONS FOR IRRADIATION FOR NEONATES

Fetal:
Intrauterine transfusion (IUT)

Neonatal:
Previous IUT until 6 months after expected delivery date
Neonatal exchange transfusion
VLBW infants (< 1200g) until 4 months of age
Congenital severe T cell immune deficiency - until proven and when confirmed present
Complex congenital cardiac abnormalities (22q11.2 deletion) - until proven and when confirmed present

RISKS WITH IRRADIATION

Irradiation also damages red cell membrane – leads to increased rate of potassium loss.

- Irradiation causes K^+ to accumulate in the supernatant during storage.
- Can be a problem for neonates if receiving large volume transfusion (hyperkalemia).
- Red cells for neonates & pediatrics should be irradiated close to the time of issue as possible or remove supernatant if more than 24 hours after irradiation.

BLOOD ADMINISTRATION

NEONATE & PEDIATRIC CONSIDERATIONS

INFORMED CONSENT

- Decision making in the pediatric population is complicated - wide variation in psychological development that occurs from childhood to adolescence.
- Infants/younger children – parents/caregivers are de facto decision makers and give informed consent.
- Adolescence – gets more complicated.
  - Age to give informed consent varies from province to province.
  - Adolescents with decision-making capability should give informed consent themselves.
  - Follow local protocols.

Case:

- 18 mL red cells to be infused

What would be an appropriate gauge to use for IV access with this baby?

A. 18 gauge
B. 20 gauge
C. 22 gauge
D. 25 gauge

EQUIPMENT - IV ACCESS, FILTER / TUBING

IV Access:

- IV gauge must be large enough to allow adequate flow rate and avoid cell damage. Pediatrics: **22 – 25 gauge**
- IV access must be dedicated to the blood transfusion.

Filter / Tubing:

- 170 – 260 micron blood filter
- Prime filter & tubing with the blood component or compatible IV fluid

Infusion Pump / Blood Warmers:

- Follow local protocols for use of approved infusion pumps
- Blood warmer – not typically needed for small volume transfusion in neonates or pediatrics

RATE OF INFUSION

Initial Rate of Infusion (for first 15 minutes)

- Need to start slowly
- Pediatrics: suggested rate is **1ml/kg/hr** to a maximum of **50 ml/hr**

After 15 minutes:

- If tolerating the transfusion – can increase rate to prescribed rate
- Usual administration rate for neonates/ pediatrics is **5 ml/kg/hr,** up to **150 ml/hr**

Clinical Guide of Transfusion, Canadian Blood Services
Bloody Easy Administration, ORBCoN

MONITORING

- Monitor closely
- Patient may not be able to verbalize
- May be at risk for transfusion associated circulatory overload (TACO)
- Monitor IV site (especially with neonates) – IV can go interstitial
- Watch for signs of a transfusion reaction and be prepared to stop the transfusion

Bloody Easy Administration, ORBCoN

CASE

Received small volume red cell transfusion

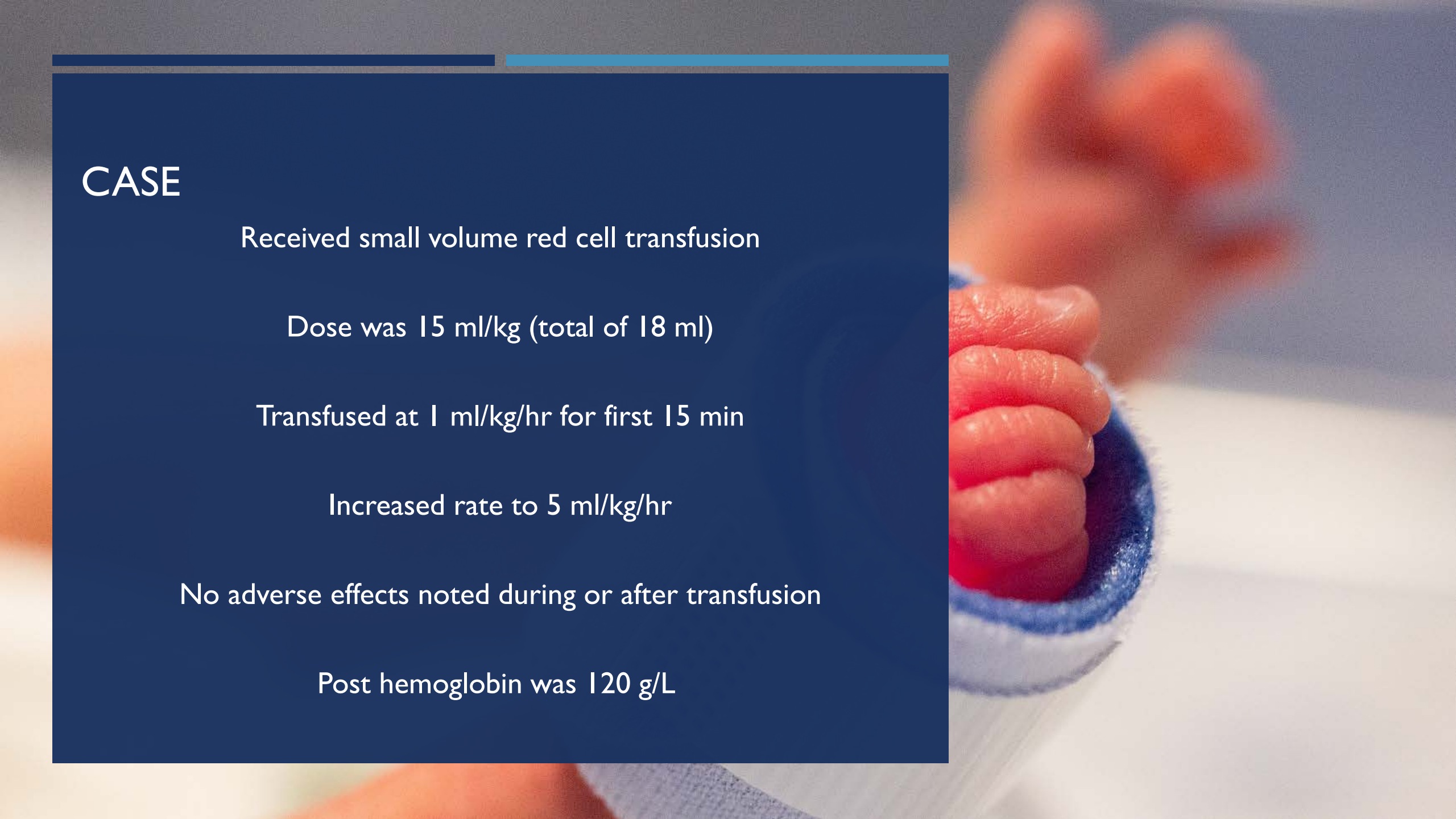
Dose was 15 ml/kg (total of 18 ml)

Transfused at 1 ml/kg/hr for first 15 min

Increased rate to 5 ml/kg/hr

No adverse effects noted during or after transfusion

Post hemoglobin was 120 g/L



KEY POINTS

- Iatrogenic blood loss can worsen or cause anemia, resulting in potential need for transfusion.
- For neonate & younger pediatrics, red cell transfusions are typically ordered in ml/kg rather than units.
- Pediatric dose for red cells is 10 – 20 ml/kg. (10 ml/kg should raise hemoglobin by 10 g/L).
- For neonates, another Type & Screen sample is not required until they are 4 months of age if their initial antibody screen is negative (during the same admission).
- For neonates, red cells should be compatible with mother & baby when they have different blood groups.
- IV access with 22 – 25 gauge size is acceptable for red cell transfusions in pediatrics.
- Starting rate for neonatal /pediatric transfusions is 1 ml/kg/hr (max 50 ml/hr).

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TRANSFUSION KNOWLEDGE QUESTIONS POST

What is the typical dose for a small volume red cell transfusion for neonates and paediatrics?

A. 20 - 30 ml/kg
B. 10 - 20 ml/kg
C. 5 -10 ml/kg
D. 1- 5 ml/kg

TRANSFUSION KNOWLEDGE QUESTIONS POST

When would a new type and screen specimen need to be collected for a neonate with a negative antibody screen?

A. Every 96 hours
B. When the baby reaches 1 month of age
C. When the baby reaches 4 months of age
D. When the baby reaches 6 months of age

TRANSFUSION KNOWLEDGE QUESTIONS POST

What is the smallest gauge/lumen size recommended as acceptable for transfusing red cells in paediatrics?

A. There is no minimum size
B. 20
C. 22
D. 25

Thank You!

Questions?