Neonatal transfusion

Samaneh Abdolahzadeh
Pediatrician
Whole Blood
Neonatal red cell exchange transfusion

- mainly used in the treatment of severe hyperbilirubinaemia or hemolytic anemia. It removes antibody-coated neonatal red cells and reduces the level of plasma unconjugated bilirubin (the cause of bilirubin encephalopathy). The steep decline in the incidence of HDFN following the introduction of maternal anti-D Ig prophylaxis, more effective antenatal monitoring and treatment, and the use of intensive phototherapy and intravenous immunoglobulin postnatally has made red cell exchange transfusion an uncommon procedure that should only be performed in specialist units by experienced staff. A ‘double volume exchange’ (160–200 mL/kg) removes around 90% of neonatal RBC and 50% of bilirubin.

- The component should be warmed to 37°C immediately before transfusion. It should be irradiated if this requirement does not cause clinically important delay in provision (irradiation is essential if the baby has received IUT).
Red cells for neonatal exchange transfusion

- Plasma reduced with HCT of 0.5–0.6 to reduce the risk of post-exchange polycythaemia
- Less than 5 days old
- Irradiated (essential if previous IUT)
- CMV negative
- Sickle screen negative
- Usually produced as group O (with low-titre haemolsins)
- RhD negative (or RhD identical with neonate) and Kell negative
- Red cell antigen negative for maternal alloantibodies
- IAT crossmatch compatible with maternal plasma
Pack cell
Neonatal ‘top-up’ transfusion

- Repeated small-volume ‘top-up’ red cell transfusions (up to 20 mL/kg) are commonly carried out in preterm babies, mainly to replace losses from repeated blood testing exacerbated by reduced red cell production (‘anaemia of prematurity’).

- Up to 80% of preterm babies weighing less than 1500 g at birth are transfused at least once.

- Indications for transfusion in this group have largely been based on the Hb concentration combined with the cardiorespiratory status of the baby (e.g. requirement for oxygen or ventilatory support) and factors such as weight gain, although the evidence base is weak.
liberal or restrictive red cell transfusion policies

- Several randomised controlled trials have addressed the risks and benefits of liberal or restrictive red cell transfusion policies in very low birth weight infants. A systematic review by the Cochrane Collaboration in 2011 found a modest reduction in exposure to transfusion in the restrictive transfusion groups and no significant difference in mortality, major morbidities or survival without major morbidity. The approximate lower limits used to define a ‘restrictive’ transfusion policy in these trials are shown in Table 10.5. Although many experts now favour a restrictive transfusion policy
<table>
<thead>
<tr>
<th>Postnatal age</th>
<th>Suggested transfusion threshold Hb (g/L)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ventilated</td>
<td>On oxygen/CPAP</td>
</tr>
<tr>
<td>First 24 hours</td>
<td>&lt;120</td>
<td>&lt;120</td>
</tr>
<tr>
<td>≤Week 1 (days 1–7)</td>
<td>&lt;120</td>
<td>&lt;100</td>
</tr>
<tr>
<td>Week 2 (days 8–14)</td>
<td>&lt;100</td>
<td>&lt;95</td>
</tr>
<tr>
<td>≥Week 3 (day 15 onwards)</td>
<td></td>
<td>&lt;85</td>
</tr>
</tbody>
</table>
Table 10.5 Approximate capillary Hb transfusion thresholds used for ‘restrictive’ transfusion policies in studies evaluated by the Cochrane Review

<table>
<thead>
<tr>
<th>Postnatal age</th>
<th>Respiratory support</th>
<th>No respiratory support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>115 g/L</td>
<td>100 g/L</td>
</tr>
<tr>
<td>Week 2</td>
<td>100 g/L</td>
<td>85 g/L</td>
</tr>
<tr>
<td>Week 3</td>
<td>85 g/L</td>
<td>75 g/L</td>
</tr>
</tbody>
</table>

Many neonatal red cell transfusions are given to replace losses from frequent blood sampling. This can be
1. Asymptomatic infants with Hct ≤18% (Hb ≤6 g/dL) and reticulocytes <100,000 cells/μL (<2%)

2. Infants with Hct ≤20% (Hb ≤7 g/dL) on supplemental oxygen who are not requiring mechanical ventilation but have one or more of the following:
   a. ≥24 hours of tachycardia (heart rate >180 bpm) or tachypnea (respiratory rate >80 breaths per minute)
   b. A doubling oxygen requirement from the previous 48 hours
   c. Acute metabolic acidosis (pH <7.20) or lactate ≥2.5 mEq/L
   d. Weight gain of <10 g/kg/day for 4 days while receiving ≥120 kcal/kg/day
   e. If the infant will undergo major surgery within 72 hours

3. Infants with Hct ≤25% (Hb ≤8 g/dL) requiring minimal mechanical ventilation, defined as MAP ≤8 cm H2O by CPAP or conventional ventilation, or MAP <14 on high-frequency ventilation, and/or FiO2 <0.40

4. Infants with Hct ≤30% (Hb ≤10 g/dL) requiring moderate or significant mechanical ventilation, defined as MAP >8 cm H2O on conventional ventilation, or MAP >14 on high-frequency ventilation, and/or FiO2 >0.40

5. A transfusion should be considered if acute blood loss of ≥10% associated with symptoms of decreased oxygen delivery occurs, or if significant hemorrhage of ≥20% total blood volume occurs.

15 to 20 mL/kg
Many neonatal red cell transfusions are given to replace losses from frequent blood sampling.

Donor exposure can also be reduced by allocating single donor units, split into ‘paedipacks’, to babies predicted to need more than one transfusion episode within the expiry date of the donation.

The typical transfusion volume is 10–20 mL/kg (higher end of dose for severe anaemia or bleeding) administered at 5 mL/kg/h.

Top-up transfusions in excess of 20 mL/kg are not recommended because of the risk of transfusion-associated circulatory overload (TACO).
Transfusion criteria or transfusion "trigger values" can vary from center to center and from neonatologist to neonatologist.

It is important for each NICU to develop guidelines for transfusions that ensure a consistent approach.

Without written guidelines, "you will be transfusing more than you should."
Keep the hematocrit > 35% if the infant is mechanically ventilated

Keep the hematocrit > 28% if there are signs of anemia:
- unexplained lethargy
- weight gain < 10 g/kg despite adequate calories
- heart rate > 165 for > 48 hours
- unexplained apnea

Keep the hematocrit > 20% even if no signs of anemia are detected.
RBC grouping

- During the first 4 months of life ABO antigens may be poorly expressed on red cells and the corresponding ABO antibodies may not have yet developed (making confirmation by ‘reverse grouping’ unreliable). Maternal IgG ABO antibodies may be detected in neonatal plasma. Wherever possible, samples from both the mother and infant should be tested for ABO and RhD grouping, an antibody screen should be performed on the larger maternal sample, and a direct antiglobulin test (DAT) on the infant’s sample.

- Because of the significant risk of ‘wrong blood in tube’ errors due to misidentification, the infant’s blood group should be verified on two separate samples (one of which can be a cord blood sample) as recommended for adult patients, providing this does not delay the emergency issue of blood.
received IU1 or has a proven or suspected T-cell immunodeficiency disorder.

### Table 10.6 Red cells for small-volume transfusion of neonates and infants

<table>
<thead>
<tr>
<th>Requirement</th>
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<tbody>
<tr>
<td>Haematocrit 0.5–0.7</td>
</tr>
<tr>
<td>In SAG-M anticoagulant/additive solution (approximately 20 mL residual plasma)</td>
</tr>
<tr>
<td>Up to 35 days from donation</td>
</tr>
<tr>
<td>Group O (or ABO-compatible with baby and mother) and RhD negative (or RhD compatible with the neonate)</td>
</tr>
<tr>
<td>In practice, many hospitals use O RhD negative</td>
</tr>
<tr>
<td>CMV seronegative for neonates</td>
</tr>
</tbody>
</table>

10.3.4: Neonatal platelet transfusions
Neonatal platelet transfusions

- Severe thrombocytopenia (<50×10⁹/L) is a common finding in infants treated on NICUs, especially in sick preterm neonates.
- There is no clear correlation between the severity of thrombocytopenia and major bleeding, such as IVH, suggesting other clinical factors are important.
- Contrary to many published guidelines, the majority of platelet transfusions are given as ‘prophylaxis’ in the absence of bleeding.
- CMV-negative and ABO RhD identical or compatible with the recipient.
- A typical dose is 10–20 mL/kg.
معیارهای ترانسفوزیون پلاکت در نوزادان:

- تعداد پلاکت کمتر از 30000:
  تزریق پلاکت بدون هیچ میار

- تعداد پلاکت بین 30000 - 49000:
  وزن زمان تولد کمتر از 1500 گرم، سن نوزاد 7 روز یا کمتر، ناپایداری بالینی، اختلال انعقادی هم‌مان، خونریزی قابل ملاحظه (خونریزی داخلی بطنی درجه سه و چهار) قبل از بروسیجر جراحی، دوره بعد از جراحی (72 ساعت)

- پلاکت بین 50000-100000:
  خونریزی فعال، ترومبوپتتوئیز آلایمون نوزادی با خونریزی داخلی جمجمه، قبل یا بعد از بروسیجر
  نرسرجه
In the absence of platelet destruction (such as DIC, immune destruction, or sepsis), 1 unit of random donor platelets should raise the platelet count by 50,000 to 100,000/mm³ in a neonate.

The platelet count will drop over 3 to 5 days unless platelet production increases.
Neonatal FFP and cryoprecipitate transfusion

- Normal neonates have different, age-related values for common coagulation screening tests compared to older children and adults. This complicates the diagnosis of ‘coagulopathy’.
- At birth, vitamin-K-dependent clotting factors are 40–50% of adult levels and are lowest in preterm infants. The (PT), (TT) and (APTT) may be longer, although overall haemostatic function may be normal.
- (DIC) is common in sick neonates and haemorrhagic disease of the newborn due to vitamin K deficiency may cause major bleeding in babies who have not received appropriate vitamin K prophylaxis at birth.
- FFP should be used for:
  - Vitamin K deficiency with bleeding
  - DIC with bleeding
  - Congenital coagulation factor deficiencies where no factor concentrate is available (Factor V deficiency)
- It should be ABO identical with the recipient or group AB (group O FFP should only be given to neonates of group O)

- The dose of FFP is usually 12–15 mL/kg. The degree of correction is unpredictable and clotting tests should be repeated after administration.

- FFP should not be used as routine prophylaxis against peri/intraventricular haemorrhage in preterm neonates or as a volume replacement solution, or just to correct abnormalities of the clotting screen.
Cryoprecipitate

- is used as a more concentrated source of fibrinogen than FFP and
- is primarily indicated when the fibrinogen level is $<0.8$–$1.0$ g/L in the presence of bleeding from acquired or congenital hypofibrinogenaemia.
- The usual dose is $5$–$10$ mL/kg.
جدول ۳-۱۸: سازگاری گروه ABO فراورده های خون در تعویض خون نوزادان

<table>
<thead>
<tr>
<th>Infant’s Group</th>
<th>Mother’s Group</th>
<th>Donor Red cells</th>
<th>Donor FFP</th>
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</thead>
<tbody>
<tr>
<td>O</td>
<td>O, A, B</td>
<td>O</td>
<td>O, A, B, AB</td>
</tr>
<tr>
<td>A</td>
<td>O, B</td>
<td>O</td>
<td>A, AB</td>
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<tr>
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<tr>
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<td>B, AB</td>
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<tr>
<td></td>
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<tr>
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<td>AB</td>
<td>AB, A, B, O</td>
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<tr>
<td>سرعت تزریق</td>
<td>دوز (ml/kg)</td>
<td>فرآورده</td>
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<tr>
<td>------------</td>
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<td></td>
</tr>
<tr>
<td>۵-۱۵ ml/kg/ hr</td>
<td>۱۰-۱۵ ml/kg</td>
<td>گلوبول قرمز (RBC)</td>
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</tr>
<tr>
<td>۶۰-۱۲۰ ml/hr</td>
<td>۱۰-۱۵ ml/kg</td>
<td>پلاسمای نازه منجمد (FFP)</td>
<td></td>
</tr>
<tr>
<td>۱۲۰-۲۰۰ ml/hr</td>
<td>۵-۱۰ ml/kg</td>
<td>پلاکت</td>
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<tr>
<td>سریع در جدی که بیمار تحمل نماید</td>
<td>۲-۱ واحدهای ازای ۱۰ کیلوگرم</td>
<td>کرابوپرسبینت</td>
<td></td>
</tr>
<tr>
<td>۳۵-۱۰۰ ml/hr</td>
<td>۱۰-۱۵ ml/kg</td>
<td>گرانولوست</td>
<td></td>
</tr>
</tbody>
</table>