Paediatric and Neonatal transfusion – your questions answered

Introduction and Risks

Helen New
Consultant in Paediatric Transfusion Medicine
NHS Blood and Transplant
Transfusion decisions

- Risks vs benefits
- Clinical situation
- Transfusion thresholds
- Doses
- Special components
- Alternatives to transfusion?

- What is the evidence?
- ‘Patient blood management’ (PBM)
- Paediatric guidelines
Paediatric Transfusion Guidelines

- Canadian
- The Netherlands
- US: AABB
- Italian
- UK ‘NICE’ 2015 – not < 1 yr
- Australian National Blood Authority PBM 2016

PLUS Local guidelines
Guidelines on transfusion for fetuses, neonates and older children

Helen V. New,1,2 Jennifer Berryman,3 Paula H. B. Bolton-Maggs,4 Carol Cantwell,2 Elizabeth A. Chalmers,5 Tony Davies,6 Ruth Gottstein,7 Andrea Kelleher,8 Sailesh Kumar,9 Sarah L. Morley10 and Simon J. Stanworth,11 on behalf of the British Committee for Standards in Haematology

- Aim: to bring together most aspects of paediatric transfusion
- Writing group: clinical and laboratory specialists, including neonatology, paediatrics, anaesthetics, haematology, fetal medicine
- Two sections:
  - ‘Clinical transfusion’
  - ‘Blood components and pre-transfusion testing’
- Pragmatic, practical, educational, evidence based where possible
- ‘key practice points’ vs ‘recommendations

Background to BSH 2016

- literature evidence
- current practice
  - National Comparative Audits
    - FFP, paediatric red cell
  - user feedback
- updated specialist components
- Serious Hazards of Transfusion (SHOT)
Neonatal exchange units

- Usually group O
  - compatible with maternal antibodies
- Hct 0.5-0.55 (NHSBT)
- CMV negative
- Anticoagulant: citrate, phosphate, dextrose
- < 5 days old - reduce risk of hyperkalaemia
- Irradiated, especially if previous IUT
  - shelf life 24 hours

Approx 8000 units manufactured per annum.
Kept in ‘stock holding units’ between manufacturing centres and hospitals. Irradiated and issued to hospitals on request.
If not issued, remanufactured into standard red cell units (SAGM)
  > 7000 units pa
Guideline key updated areas

- red cell thresholds: neonatal, paediatric
- cardiac surgery
- laboratory guidance
- alternatives
- practice points relating to PBM
  - eg ‘Transfusion volumes for non-bleeding infants and children, excluding those on chronic transfusion programmes, should generally be calculated to take the post-transfusion Hb to no more than 20 g/L above the transfusion threshold, usually a maximum of one unit.’
- selection of components in emergency
- major haemorrhage
Algorithm for compatibility testing for a neonate BSH 2016

DAT = Negative
Maternal antibodies = Negative

Blood compatible with the ABO type of mother and baby can be issued without further testing until the baby is four months old.

DAT = Negative
Maternal antibodies = Positive

Blood compatible with the ABO type and antibody status of mother and baby can be issued by IAT crossmatch against neonatal plasma or maternal plasma up until four months old *

DAT = Positive
Maternal antibodies = Negative

Check for ABO incompatibility between mother and fetus.

Yes

HAEMOLYSIS SUSPECTED?

Yes — Check for antibodies to low frequency antigens by testing maternal plasma against infant red cells by IAT

PAS — IAT crossmatch against neonatal plasma or maternal plasma up until four months old *

Select units based on national guidelines regarding low frequency antibodies.

Neg - Blood compatible with the ABO type of mother and baby can be issued by IAT crossmatch against neonatal plasma or maternal plasma up until four months old *

Issue O neg paedpacks electronically

No — No further investigations required

DAT = Positive
Maternal antibodies = Positive

Phenotype the baby for the corresponding antigen

Neg

Consider elution studies and testing to see if maternal/ABO antibody can be eluted from babys cells**

Positive

** Although this represents ideal practice, an elution is not generally required unless there is haemolysis together with diagnostic uncertainty as to whether maternal antibodies are the cause.

* If using paedpacks only the first unit of the donor set requires crossmatching.

DAT, direct antiglobulin test; IAT, indirect antiglobulin test.
Guideline Bookmarks

Transfusion of Blood Components for Neonates

This summary guidance should be used in conjunction with the 2016 BSH Guidelines.

Table: Suggested transfusion thresholds for preterm neonates

<table>
<thead>
<tr>
<th>Birthweight (g)</th>
<th>Ventilated</th>
<th>Off oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1500</td>
<td>&lt;100</td>
<td>&lt;120</td>
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<tr>
<td>1500-2500</td>
<td>&lt;120</td>
<td>&lt;140</td>
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<tr>
<td>2500-3500</td>
<td>&lt;140</td>
<td>&lt;160</td>
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<tr>
<td>&gt;3500</td>
<td>&lt;160</td>
<td>&lt;180</td>
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</tbody>
</table>

Transfusion of Blood Components for Infants and Children

This summary guidance should be used in conjunction with the 2016 BSH Guidelines.

Blood and Transplant

Red cells

Acute guidelines

Studies support restrictive transfusion thresholds.

- Use Hb threshold of 70 g/L in stable non-surgical patients.
- In non-bleeding infants and children, generally aim for a post-transfusion Hb of no more than 20 g/L above the threshold.
- Maintain blood sampling and use near patient testing where possible.

Surgery (non-cardiac)

- Treat pre-op anaemia as per above.
- Use a pre-op Hb threshold of 70 g/L in stable patients without major comorbidity or bleeding.
- Consider transfusion in all children undergoing surgery at risk of significant bleeding.
- Consider cell salvage in all children at risk of significant bleeding where transfusion may be required.

Transfusion volume calculation and prescribing

Volume to transfuse (ml) =

\[ \text{desired Hb (g/dL) - actual Hb (g/dL) \times weight (kg) \times 4} \]

The formula provides a guide to the likely rise in Hb following transfusion for non-bleeding patients.

- Prescription should be in millilitres not units.
- Normal maximum volume for red cell top-up transfusion is 1 unit. Transfusion rate: 5 ml/kg/h (usual max rate 150 ml/h).

FRESH FROZEN PLASMA AND CRYOPRECIPITATE

Correction of minor acquired abnormalities in non-bleeding patients (excluding DIC)

- FFP should not be administered to non-bleeding children with minor prolongation of the aPTT (excluding prior to surgery unless CRITICAL). 
- Cryo should not be routinely administered to non-bleeding children with decreased fibrinogen (including pre-op unless fibrinogen <0.5 g/L or for surgery at risk of significant bleeding or at critical sites).

DISSEMINATED INTRAVASCULAR COAGULATION

- FFP may be beneficial in children with DIC who have a significant coagulopathy (aPTT >15 times normal range or fibrinogen <1 g/L) associated with clinically significant bleeding or prior to invasive procedures.
- Cryo may be given if the fibrinogen >0.5 g/L. Despite FFP, or in combination with FFP for very low or rapidly falling fibrinogen. Make sure that patients are vitamin K replete.

Typical transfusion volumes: FFP 15-20 ml/kg, cryo 5-10 ml/kg; rate 10-20 ml/h.
Risks?

SHOT – adverse outcome reports
  - errors, immunological reactions
  - pulmonary complications (TACO, TRALI)
Infection – viral, bacterial, vCJD
Component related: additives, K+
  Luban, et al, 1991; Lee et al Transfusion 2014
Procedure related
  eg neonatal exchange transfusion
  ‘Restrictive’ vs ‘Liberal’ transfusions
  - long term outcomes
Age of blood?
SHOT Paediatric reports 2008-15

939/12,353 total (7.6%)

Percentage of reports

‘Errors’ 61.2%  ‘Reactions’ 38.8%

Category

IBCT-WCT  IBCT-SRNM  ADU  HSE  Anti-D  ATR  HTR  Allo  TRALI  TACO  TAD  PTP  UCT  TA-GvHD  TTI  CS

% of Paediatric reports (939)

% of Adult reports (11414)
Themes of recurrent errors

- lab failure to test maternal sample for neonatal pretransfusion testing
- selection of wrong type of component for neonatal transfusion
  - obstetric ‘emergency O neg’ blood for neonatal resuscitation
  - neonatal exchange transfusion
- special requirements not met
  - understanding, communication (shared care)
  - lab IT systems inadequate/overridden
Administration errors

- prescription volumes (‘units’ not ‘mL’)

- administration errors
  - eg three way-tap on neonatal transfusion infusion sets
SHOT 2015
Categories subdivided by age group

<table>
<thead>
<tr>
<th>Category</th>
<th>≤28 days</th>
<th>&gt;28 days to &lt;1 year</th>
<th>1 to &lt;16 years</th>
<th>16 to &lt;18 years</th>
</tr>
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<tbody>
<tr>
<td>Incorrect blood component transfused (IBCT)</td>
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<td>Avoidable, delayed or under transfusion (ADU)</td>
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<td>Acute transfusion reactions (ATR)</td>
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<td>Handling and storage errors (HSE)</td>
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<td>Unclassified complications of transfusion (UCT)</td>
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<td>Haemolytic transfusion reactions (HTR)</td>
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<td>Transfusion-associated circulatory overload (TACO)</td>
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<td>Alloimmunisation (Allo)</td>
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<td>Anti-D immunoglobulin errors (Anti-D Ig)</td>
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<td>Transfusion-transmitted infection (TTI)</td>
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<td>Transfusion-related acute lung injury (TRALI)</td>
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Number of reports
Reactions: are we getting a representative picture for neonates?

- under reporting
- missed neonatal reactions?
- immunological immaturity?

- necrotising enterocolitis (NEC)?
- intraventricular haemorrhage?
- TACO, TRALI rates?
- new definitions?

What are the true risks?
Summary

- Paediatric transfusion balance of risk vs benefits
- BSH transfusion guidelines 2016
- Evidence and consensus based
- Basis for local guidelines, focus of education
- Support development of paediatric PBM
Acknowledgements

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- SHOT
  - Paula Bolton-Maggs, Debbi Poles