23 Paediatric Cases

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Definition:

Paediatric cases comprise all reports for patients under 18 years of age, including all paediatric cases from the other chapters in this report. Paediatric reports have been subdivided by recipient age group: neonates ≤28 days; infants >28 days and <1 year; children ≥1 year to <16 years and young people aged 16 to <18 years.

Key SHOT messages

- One death was reported, in part attributable to an error in the process of performing an exchange transfusion. This highlights the need for strict protocols and staff education for such procedures which are now performed relatively rarely
- Four errors were caused by acting on inaccurate or old blood results. It is key that personnel interpreting blood tests understand potential variables which will make laboratory tests unreliable. The importance of repeating unexpected results cannot be overstated
- Errors related to transfusion volumes remain an issue (6 cases). Education of staff members and sharing knowledge of guidelines and resources such as the 'Blood Components Mobile Application' (Blood Components App) is key to reducing these errors in future
- Communication errors continue to be an issue across categories. Patient groups with complex or specific requirements require meticulous communication between specialities
- Paediatric febrile, allergic and hypotensive reaction (FAHR) reports most often occurred following platelet transfusions (21/30; 70.0%), the usual FAHR pattern for paediatrics. The decision to transfuse platelets to non-bleeding patients should be taken with care, as emphasised by the results of the recent PlaNeT-2 study in preterm neonates (Curley et al. 2019)

Recommendation

- Further dissemination of the resources such as the 'Blood Components App' and awareness of British Society for Haematology (BSH) paediatric transfusion guidance (BSH New et al. 2016) should be high priority for paediatric educators (see the SHOT website https://www.shotuk.org/resources/current-resources/)

Action: Hospital Transfusion Teams, Hospital Paediatricians, Medical Educators, Royal College of Paediatrics and Child Health

Introduction and summary

This chapter summarises the reports for patients <18 years old and allows us to highlight specific learning points for clinicians caring for this age group. The general themes from year to year remain similar highlighting the need for ongoing education of colleagues of the potential pitfalls and complexities of transfusion in this age group.

In 2018 123/1659 (7.4%) of total cases were paediatric. If near miss (NM) and right blood right patient categories are included, 241/3326 (7.2%). The total number and percentage of cases was slightly lower than last year.

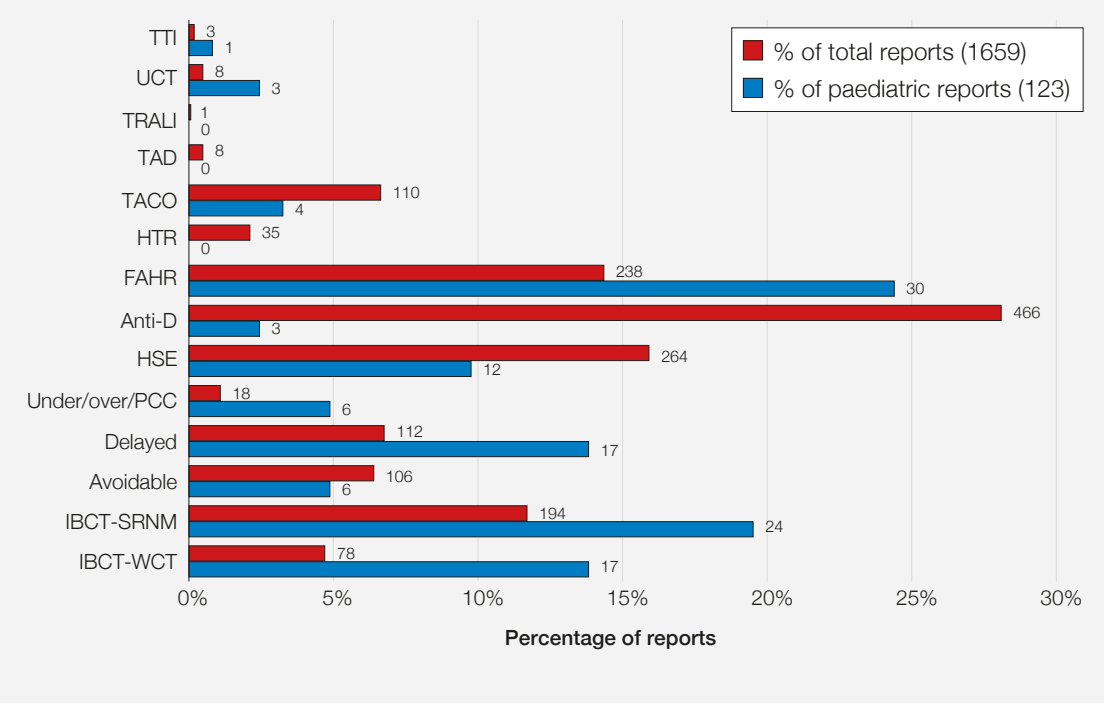


Figure 23.1: Percentages of paediatric and total reports in each category

TTI=transfusion-transmitted infection; UCT=unclassifiable complications of transfusion; TRALI=transfusion-related acute lung injury; TAD=transfusion-associated dyspnoea; TACO=transfusion-associated circulatory overload; HTR=haemolytic transfusion reactions; FAHR=febrile, allergic and hypotensive reactions; HSE=handling and storage errors; IBCT-SRNM=incorrect blood component transfused-specific requirements not met; IBCT-WCT=IBCT-wrong component transfusion

Summary data

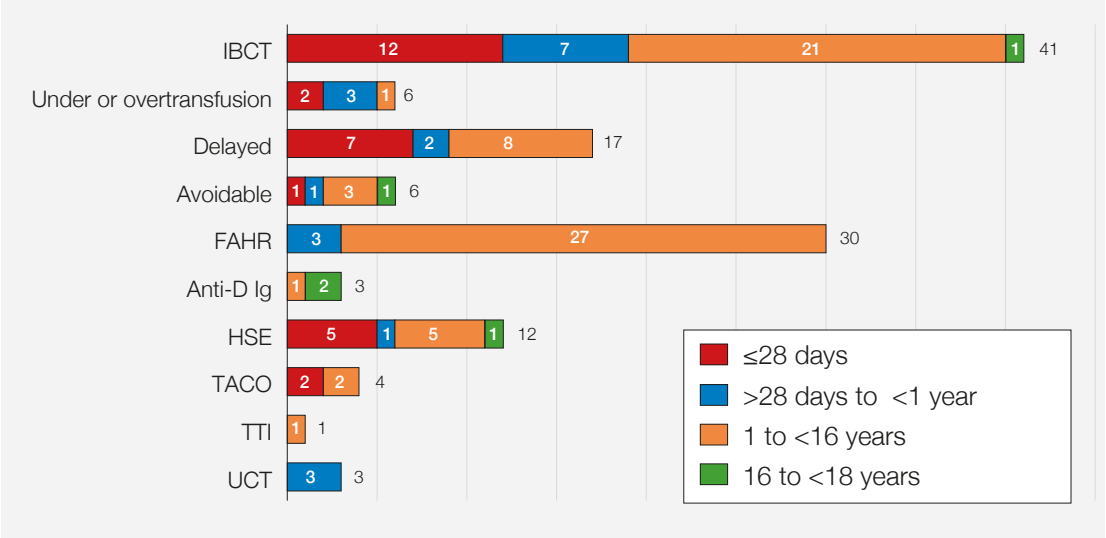
Trends of reporting are summarised in Figures 23.3a-c (b and c are available on the website only) and highlights are discussed by category. There continues to be disproportionate representation of paediatric cases as a proportion of total SHOT reports in three categories (Figure 23.1):

- Incorrect blood component transfused (IBCT) 17/78 (21.8%)
- Specific requirements not met (SRNM) 24/194 (12.4%)
- Avoidable, Delayed or Under/Overtransfusion (ADU) 29/236 (12.3%), and for the under or overtransfusion subcategory 6/15 (40.0%)

The distribution of reports in each category remains broadly similar compared with last year (Figure 23.2).

Errors which were primarily from the laboratory accounted for 40/85 (47.1%) of paediatric error reports (IBCT-WCT 9, IBCT-SRNM 16, ADU 12, HSE 3 and anti-D Ig 0), with the remainder being clinical. This number and percentage of laboratory errors is increased compared to last year, consistent with ongoing pressure in transfusion laboratories.

Figure 23.2: Summary of paediatric reports by category and age for 2018



IBCT=incorrect blood component transfused; FAHR=febrile, allergic and hypotensive reactions; HSE=handling and storage errors; TACO=transfusion-associated circulatory overload; TTI=transfusion-transmitted infection; UCT=unclassifiable complications of transfusion

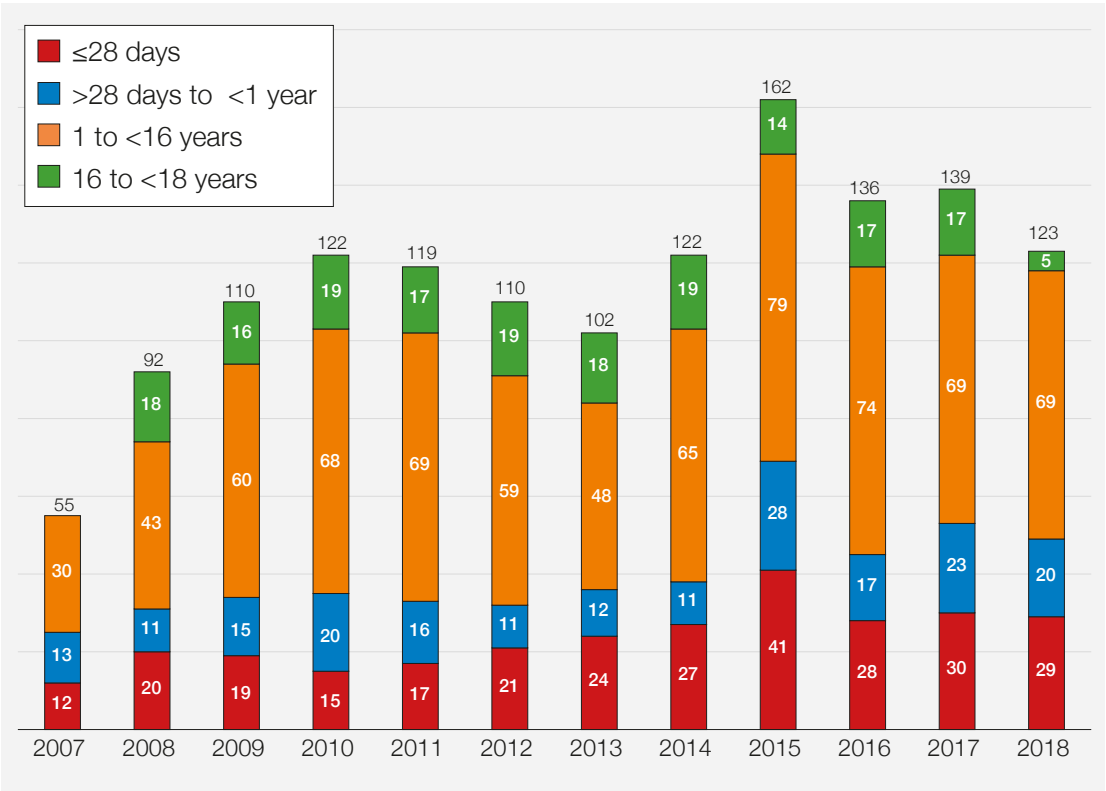
The total number of reports has reduced slightly (Figure 23.3a), mainly due to a reduction of reports in teenagers 16 to <18 years old. There was a small increase in the number of errors due to failure to appropriately supply irradiated components (Figure 23.3b - website only).

FAHR reactions to platelet components continue to predominate in paediatric patients (Figure 23.3c - website only) in contrast to the pattern for adults (Figure 23.6a).

Figures 23.3b and 23.3c for trends in specific requirements not met, and febrile, allergic and hypotensive reactions can be found in the supplementary information on the SHOT website www.shotuk.org.

a. Total paediatric reports subdivided by age

Figure 23.3: Trends in paediatric reports 2007-2018



In 2007 only cases <16 years were included

Summary by SHOT category

Death n=1

There was 1 neonatal death attributable to transfusion in 2018, reported in the transfusion-associated circulatory overload (TACO) category.

Case 23.1: TACO and death following accidental overtransfusion of three times the volume required

A preterm infant required a double volume exchange for high bilirubin. The baby deteriorated markedly 1 hour after the exchange transfusion was commenced. At this point it was noticed that nearly three times the required volume had been administered (175mL) than had been removed (70mL). This was due to three syringes of blood being accidentally run concurrently. The baby developed pulmonary oedema and then an intracranial haemorrhage. The neonatal unit involved performs approximately 5-10 procedures per year but the investigation commented that this is still sufficiently infrequent to mean that many nurses and members of the junior medical team will have limited experience.

This case highlights the hazards around neonatal exchange transfusions, particularly in very preterm neonates.

Learning point

- Neonatal exchange transfusion procedures are now performed infrequently. It is vital that local protocols exist to support the practical process of the procedure and that an accurate real time tally is kept of blood removed and transfused

Major morbidity n=15

There were 15 cases in patients <18 years which resulted in major morbidity or were severe reactions. The details of these are discussed below.

Incorrect blood component transfused (IBCT) n=1

One case of incorrect ABO transfusion in a patient who was post liver transplant, resulted in an acute haemolytic transfusion reaction and significant morbidity.

Febrile, allergic and hypotensive reactions (FAHR) n=10

Of these 8 were severe reactions to platelets and 2 to plasma (1 methylene blue-treated fresh frozen plasma (MB-FFP) and 1 Octaplas®).

Transfusion-associated circulatory overload (TACO) n=1

A teenager developed severe respiratory distress following an apheresis platelet transfusion. They required admission to the intensive care unit and recovered fully with supportive care.

Unclassifiable complications of transfusion (UCT) n=3

There were 3 cases that were reported to have resulted in major morbidity in the UCT category (see Chapter 19, New or Unclassifiable Complications of Transfusion (UCT)) and involve transfusion-associated necrotising enterocolitis (TANEC), of uncertain causal relationship to red cell transfusion in preterm neonates.

In 1 case, a preterm baby had a sudden unexpected deterioration requiring ventilation 2 hours after red cell transfusion completion, and was managed as presumed NEC due to the presence of abdominal distension and discomfort, although abdominal X-ray was not diagnostic.

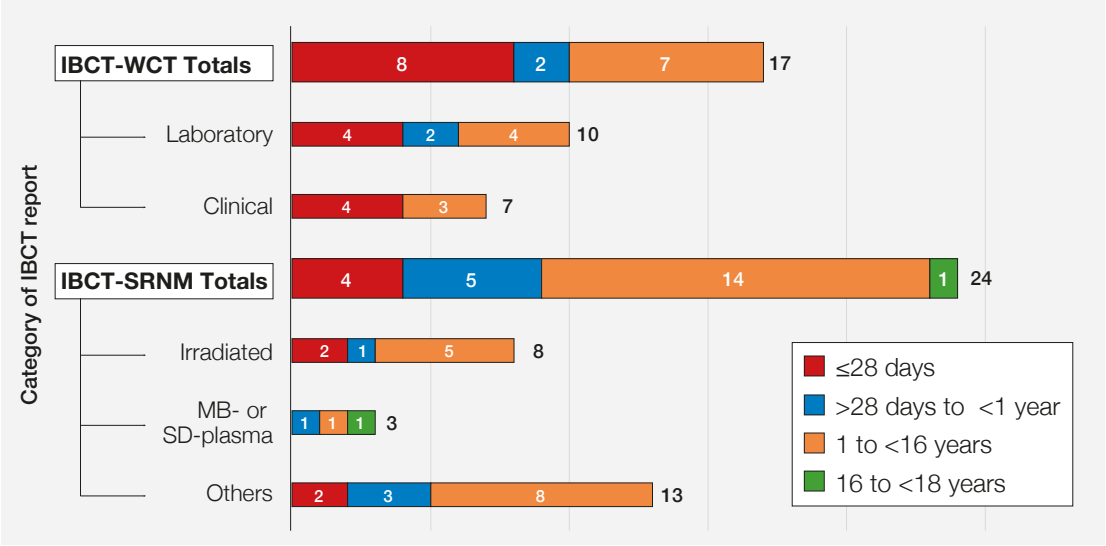
In another, a very preterm infant was diagnosed with NEC several hours after a transfusion given for anaemia (haemoglobin (Hb) 100g/L). The abdominal X-ray was consistent with NEC and the baby required extensive small bowel resection the next day, resulting in short gut syndrome. The baby had had one previous episode of suspected NEC at 10 days of age. The last case, involved a preterm baby who developed NEC 2 days following a red cell transfusion and required a hemicolectomy.

The pathogenesis of TANEC remains poorly understood, and there is uncertainty as to whether feeds should be discontinued around the time that a red cell transfusion is given to pre-term babies. Currently there is heterogenous practice across neonatal units. An ongoing multi centre 'opt-out' randomised control study, the WHEAT trial (Withholding feeds around packed red cell transfusion) hopes to answer this question (Hilditch et al. 2018).

Error-related reports n=85

IBCT-wrong component transfused (IBCT-WCT) n=17

Figure 23.4: Breakdown of incorrect blood component transfused reports



IBCT-WCT=incorrect blood component transfused-wrong component transfused; IBCT-SRNM=IBCT-specific requirements not met; MB=methylene blue-treated; SD=solvent-detergent treated

IBCT-WCT clinical errors n=7

Adult emergency blood given to neonates n=2

There were 2 reports of inappropriate use of adult group O D-negative units being given to neonates. These illustrate again the importance of clear processes to allow identification of the units for neonatal use in an emergency, highlighted in the learning point from the 2017 Annual SHOT Report (Bolton-Maggs et al. 2018):

'Neonatal/infant specification blood has additional safety features in view of the particular vulnerability of the recipients. Therefore, it is not appropriate to resuscitate neonates with adult red cells unless there is no available paedipack. Mitigations put in place by hospitals to reduce the chance of selecting the incorrect component by clinical staff include having neonatal and adult red cell units placed in containers with visual identifiers to help staff distinguish between them.'

Failure to communicate relevant medical history n=2

Communication failures with regards to key parts of medical history include failure to communicate a past history of stem cell transplantation in 2 reports.

Transfusion process errors/wrong blood in tube n=3

Errors were seen both in sample labelling and in ensuring the correct wristband was on the correct patient. On 1 occasion a child had the wristband of another patient who was due a transfusion on the same day and of note a bedside check was not performed.

On 2 occasions twins were mixed up with 1 case of wrong blood in tube and for another pair of twins the wrong twin was transfused.

IBCT-WCT laboratory errors n=10

Failure to communicate relevant medical history or failure to upload to transfusion record n=4

Two children post liver transplant and 1 post stem cell transplant received blood of the incorrect group; 2 were due to failure to communicate between clinicians and the hospital transfusion laboratory that the patient had received a transplant and 1 was due to failure to record relevant information in the transfusion information technology (IT) system.

In addition, 1 baby had an incorrect blood group assigned post intrauterine transfusion.

Case 23.2: Transfusion of red cells of the wrong group to a neonate due to a failure to communicate the previous intrauterine transfusions (IUT)

A baby received three transfusions of group O D-negative red cells in utero. Following delivery, the baby's group was reported as O D-negative, and group O D-negative plasma and platelets were issued and transfused. In view of the IUT the baby should have received group AB plasma components. This error occurred because the fetal and newborn case records had not been merged.

Learning point

- It is vital the history of in utero transfusions is communicated with the hospital transfusion laboratory staff. If this does not occur errors can be made in assigning the neonatal blood group to the group of the blood given for the intrauterine transfusion (IUT)

Component selection error, incorrect component n=6

Two neonates who were receiving large volume red cell transfusions did not receive the appropriate specialised component available due to failure to select the correct component in the transfusion laboratory. There were also 2 neonates who received cryoprecipitate instead of FFP. For 1 both FFP and cryoprecipitate had been requested but cryoprecipitate was incorrectly located in the laboratory and the collecting staff did not realise they had collected cryoprecipitate not FFP. The baby received double the intended volume of cryoprecipitate. For the second case FFP had been requested but the biomedical scientist (BMS) issued cryoprecipitate instead in error. This was not realised by the staff collecting the unit or the nurses who administered it to the patient.

A D-negative female of childbearing potential received a unit of D-positive platelets with no explanation recorded as to the reason.

Learning point

- Group O plasma can contain high levels of anti-A and anti-B which can cause significant haemolysis of red cells of recipients. Methylene-blue treated fresh frozen plasma (MB-FFP) is not currently tested for high-titre antibodies. Group O FFP should only be given to group O patients (BSH New et al. 2016)

Specific requirements not met (SRNM) n=24

Failure to provide irradiated components n=9

Non-irradiated components were supplied in error in 9 cases. Of note 4 of these were in children with DiGeorge syndrome. Three had received medications associated with a recommendation to use irradiated components, 1 was pre stem cell transplant and 1 was a neonate (who also did not have a valid antibody screen).

Case 23.3: Child with DiGeorge syndrome transfused non-irradiated components

A child was under-going tetralogy of Fallot repair in theatre but the surgical team had not been informed of the diagnosis of DiGeorge syndrome. The genetic results were available but had been filed in a second set of temporary notes for the patient and only the original set was available at time of operation. In addition, the parents had not been informed of the result.

Learning point

- With multiple clinical teams involved in the care of complex patients, timely communication between teams is vital to ensure patient safety. Electronic medical records could help in addressing this issue

Failure to provide extended phenotype blood for sickle patient n=4

For 4 patients with sickle cell disease the communication failure resulted in the provision of non-extended phenotype blood or non-K matched blood.

Learning point

- Transfusions for patients with transfusion-dependent anaemia such as sickle cell anaemia or thalassaemia may take place at non-specialist centres. It is vital therefore that education regarding the specialist requirement for red cell phenotyping is communicated amongst general paediatric teams

Failure to perform antibody screen or inappropriate transfusion of antigen-positive blood n=6

In 3 patients red cell components were issued without a valid antibody screen. One patient with a known red cell alloantibody (anti-Jk^{a}) was transfused antigen-positive blood. This was due to failure to update a laboratory flag; fortunately, there were no clinical sequelae. The remaining 2 children did not have a second group and antibody screen sent.

Failure to provide imported plasma for a recipient born on or after 1 January 1996 n=3

On 3 occasions a standard United Kingdom (UK) component was given to a child born after 1995. Two of these involved standard UK FFP units transfused to paediatric patients. The third was a neonate who received part of a standard pooled cryoprecipitate unit.

Other n=2

A patient requiring human leucocyte antigen (HLA)-matched platelets due to HLA antibodies was given non-HLA matched due to a failure to update the laboratory IT system with the results. Another patient with aplastic anaemia received pooled instead of apheresis platelets due to failure to check for specific requirements on the patient's record.

Avoidable delayed or under or overtransfusion (ADU) n=29

This category highlights the need for ongoing prescribing education for paediatricians/neonatologists and further promotion of tools such as the 'Blood Components App' to try and improve education as to the prescription of correct component volumes.

Avoidable n=6

In 6 patients transfusion could have been avoided. For 1 neonate a low Hb result from the previous day was reviewed and a transfusion commenced even though the baby had already been transfused the previous night. An incorrect decision to transfuse followed erroneous results for 4 children (see Case 23.5), and 1 apparently asymptomatic teenager with iron deficiency received a two-unit red cell transfusion.

Case 23.4: Acting upon erroneous blood test results

A child presented as an emergency. The full blood count showed pancytopenia and a platelet transfusion was administered overnight. When a cannula was re-sited the next day the blood count was repeated and was normal. Blood transfusion was discontinued. The initial sample was erroneous.

Learning point

- Phlebotomy in babies and young children can be technically challenging and sample volumes can be small. Therefore, issues regarding inaccurate results due to pre-analytical variables are potentially overrepresented in this patient group. It is vital that clinicians feel able to challenge unexpected blood test results and understand the role of sampling and testing errors when interpreting results which do not fit with the clinical situation

Overtransfusion n=5

Overtransfusion occurred as a result of miscalculation of volume required in 4 cases and in 1 case was due to mis-setting of a pump which failed to stop part way through a second neonatal split pack. Two of the children who were overtransfused red cells required venesection. A further case of significant neonatal overtransfusion of platelets is detailed in the TACO section.

Case 23.5: Miscalculation of red cell transfusion volume required

An infant requiring transfusion of red cells, weight 6.2kg, Hb 110g/L aiming at 140g/L, was prescribed a unit over 3 hours. The post-transfusion Hb was 190g/L, following a transfusion of over 30mL/kg. The error in prescription was noted the next day resulting in venesection of 50mL and replacement with fluid. The electronic prescribing programme used in this paediatric intensive care unit defaulted to units and the prescriber had to go to a second page, which was not done in this case. The review noted this system was not fit for purpose in paediatrics and was to be entered onto the risk register.

Delay in transfusion n=17 (one of these was also an undertransfusion)

There were 6 cases due to communication errors, 1 of these was when a crossmatched unit was transferred with a patient in an ambulance from another hospital and a delay occurred due to lack of guidance of what to do in this situation. Another 2 were due to issues around IT systems. One case illustrates the key importance of communication of important issues around units supplied to the clinical team: the short expiry of a unit was not discussed between the Blood Service and the hospital transfusion laboratory.

Case 23.6: Failure to communicate short expiry of neonatal exchange red cell unit

The neonatal unit requested red cells for neonatal exchange from the transfusion laboratory. The time that the exchange transfusion was scheduled to occur was later than planned and the red cells provided by the Blood Service had only 4 hours before expiry. The exchange had to be stopped before the full volume had been delivered and further blood had to be crossmatched the next day. The short expiry should have been discussed with the hospital prior to supply of the units.

Pressure of work and failure to follow existing standard operating procedure (SOP) within laboratories featured in 4 reports. In 2 cases there was failure of clinical process; this included a case of failure to follow-up a child with a haemolytic anaemia following early diagnosis of jaundice. This is not a standard SHOT reporting category but is not uncommon in clinical practice.

Another case involved an incorrectly labelled unit and in a further case a sample was sent in the wrong bottle.

Undertransfusion n=1

A child received less than the prescribed volume of red cells due to stopping the transfusion early. The prescribed volume was 450mL, however 385mL was administered.

Handling and storage errors (HSE) n=12

Incorrect pump setting or issues with infusion line n=5

As well as being vulnerable to errors around volume of prescribing, neonatal and paediatric transfusion recipients are at risk of error around incorrect settings on infusion pumps. Three cases were due to incorrect programming of pumps. Two cases involved transfusion of red cells through a non-blood giving set and 1 of these involved infusing red cells alongside a ketamine infusion.

Case 23.7: Incorrect infusion pump settings resulting in three times the rate of infusion intended

A young child (<10 years) was due a unit of red cells (270mL). This was intended to be infused over 3.5 hours. In error the volume to be infused was set as the rate and the volume was infused over 1 hour. The child did not suffer any ill effects.

Transfusion completed over too long a duration or past expiry time n=6

On 4 occasions transfusions were completed over too long a period. One unit had a short expiry time and transfusion was completed past the expiry date of the component. On another occasion blood was crossmatched earlier but transfused to the patient beyond the time that the crossmatch was valid.

Blood refrigerator error n=1

A unit of red cells taken from a blood refrigerator which had alarmed due to high temperature (10.2°C) was transfused to a neonate.

Anti-D immunoglobulin (Ig) administration n=3

There were 3 cases in pregnant older teenagers under the age of 18 years (see Chapter 7, Adverse Events Related to Anti-D Immunoglobulin (Ig) for details).

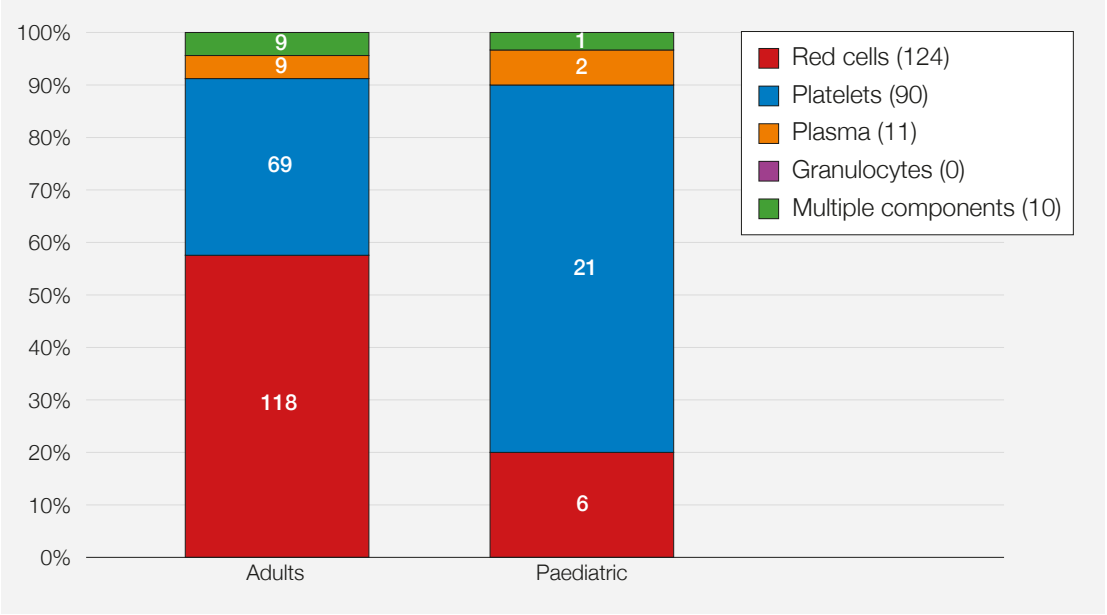
Transfusion reactions n=38

Febrile, allergic and hypotensive reactions (FAHR) n=30

The total number of cases was similar to last year (2017, n=36) with the majority occurring in children over the age of 1 year (27/30). Once again there was a predominance of allergic type reactions to platelet components in 21/30 (70.0%) with the remainder of reports being mostly febrile reactions to red cells (6), allergic reactions to plasma (2) and multiple components (1), (see Figure 23.5b).

One of the plasma reactions was to Octaplas® and one to MB-FFP. A child received Octaplas® during complex spinal surgery and became unwell with hypotension, tachycardia and reduced oxygen saturations. The child who received MB-FFP was also undergoing surgery and developed a rash, hypotension, tachycardia and reduced oxygen saturations after 160mL had been infused. Both children made a full recovery.

a. Comparison of proportions of adult and paediatric FAHR related to different components



b. Percentages of reaction types for each component for paediatric reports

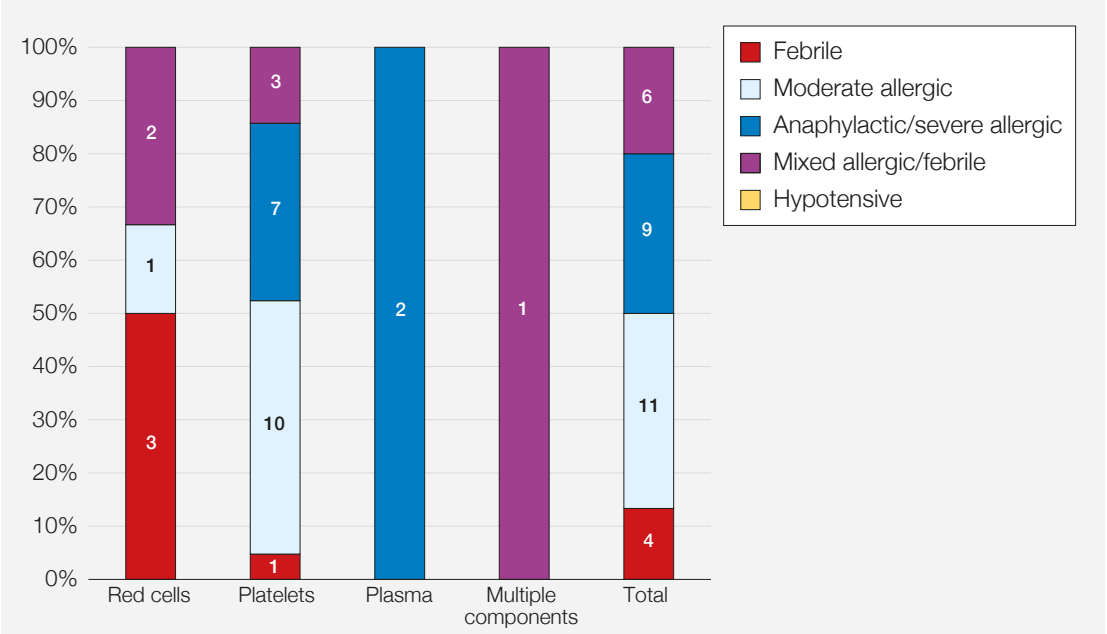


Figure 23.5: Paediatric febrile, allergic and hypotensive reaction (FAHR) reports a. Comparison of proportions of adult and paediatric FAHR related to different components

There were no FAHR reported following neonatal transfusions, as is typical from previous Annual SHOT Reports. It is not known whether this lack of reports from neonates is the result of their immunological immaturity or whether reactions may be missed in babies who are often unwell for other reasons. The results of the recent PlaNeT-2/MATISSE randomised trial of prophylactic platelet thresholds in preterm neonates (Curley et al. 2019) reported an increase in the outcome of major bleeding and mortality in the group receiving more platelet transfusions. The reasons for the evidence of harm with platelet transfusions is not known, but might include an immune-modulatory process.

Transfusion-associated circulatory overload (TACO) n=4

Respiratory complications of transfusion are likely to remain under-recognised, particularly in neonatal or complex patients who may not have risk factors seen more commonly in adult patients.

Two of the reports were due to transfusion of excessive volumes of component in error to neonates. One resulted in death (described at the start of the chapter, Case 23.1). The second excessive transfusion is described in Case 23.8. The remaining 2 cases were in a young child and a teenager and both had been given appropriate volumes.

Case 23.8: Neonate transfused ten times the required volume of platelets

A 2.9kg neonate with thrombocytopenia absent radii syndrome was prescribed 290mL instead of 29mL of platelets to be given prophylactically to cover a procedure. The prescription was written on a paper prescription chart. An adult sized pack of platelets was issued and transfused by the neonatal team. Approximately 200mL was administered before the error was noticed. The child developed respiratory distress and reduced oxygen saturation with chest X-ray changes consistent with fluid overload. Post-transfusion platelet count was 767x10^9/L. Diuretics and supplemental oxygen were given and the baby made a full recovery.

The prescribing error was not picked up by either the laboratory or the ward staff.

Learning point

- Whilst the prescriber is responsible for calculating and prescribing the correct volume of blood component, laboratory staff should be empowered to check and question inappropriate volumes requested, and ward staff administering blood components to neonates and children should be trained in the appropriate volumes to transfuse

Transfusion-transmitted infections (TTI) n=1

In 2018 there was 1 case of TTI reported in the paediatric population. This was probable bacterial contamination of platelets. A child with a brain tumour developed a fever following a prophylactic platelet transfusion. Fever persisted for 24 hours post transfusion and blood cultures were positive for Gram positive cocci (see Chapter 20, Transfusion-Transmitted Infections (TTI), Case 20.1, for further details).

Uncategorised complications of transfusion (UCT) n=3

There were 3 cases in this category, all of which were related to NEC in preterm infants. They all resulted in major morbidity and are highlighted above.

Other reaction categories

There were no cases reported in 2018 of HTR, TAD or TRALI in patients less than 18 years of age.

Near miss n=103

These near miss reports included 46 cases of wrong blood in tube that involved mother and baby samples.

Right blood right patient n=15

For further details of right blood right patient errors, see Chapter 13, Right Blood Right Patient (RBRP).

References

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