22.

Paediatric Cases

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Definition

Paediatric cases comprise all those occurring in patients under 18 years of age.

Paediatric cases 2011

This chapter analyses the data on paediatric cases from the other chapters in this annual report. All the cases are also included in the data in their respective chapters apart from the two reports of 'previously uncategorised complication of transfusion' (PUCT). All children < 18 years of age are included and have been subdivided by age groups: neonates ≤ 28 days; infants > 4 weeks and < 1 year old; and children < 16 years - because each of these has recommendations regarding blood components.

Table 22.1 Summary of paediatric cases 2011

Category of case	No ≤28 days	No >28 days to <1 year	No 1 to <16 years	No 16 to <18 years	Total paediatric cases
IBCT (total)	**7**	**4**	**17**	**2**	**30**
IBCT WCT	6	2	6	1	15
IBCT WCT Clinical	*2*	*0*	*2*	*0*	*4*
IBCT WCT Laboratory	*4*	*2*	*4*	*1*	*11*
SRNM (total)	1	2	11	1	15
Irradiated	*1*	*1*	*4*		*6*
CMV negative			*3*		*3*
Irradiated and CMV negative			*1*		*1*
MB-FFP		*1*	*2*		*3*
Others			*1*	*1*	*2*
I&U	**2**	**3**	**3**	**3**	**11**
HSE	**4**	**5**	**5**	**0**	**14**
Anti-D related	**0**	**0**	**2**	**3**	**5**
ATR	**3**	**2**	**37**	**6**	**48**
HTR/DSTR	**0**	**0**	**2**	**0**	**2**
TRALI	**0**	**0**	**0**	**1**	**1**
TACO	**1**	**0**	**2**	**2**	**5**
TAD	**0**	**0**	**1**	**0**	**1**
PUCT	**0**	**2**	**0**	**0**	**2**
TOTAL	**17**	**16**	**69**	**17**	**119**
NM	**29**	**11**	**39**	**10**	**89**
RBRP	**4**	**4**	**3**	**0**	**11**

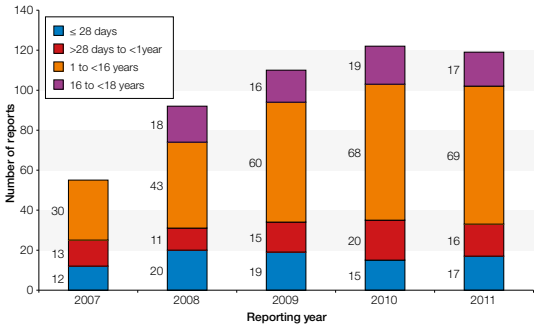
Note: There were no paediatric cases of IBCT-WBIT, PTP, TA-GVHD, TTI or CS, so these are omitted from table. Near Miss and RBRP numbers are shown separately as they are not included in the overall reporting figures. MB: Methylene-blue treated

Introduction and overall trends

This year histograms are included to demonstrate some of the trends in paediatric reports from 2007-11 (Figure 22.1 a to d). Overall numbers of reports steadily increased from 2007-2010 but have reached a plateau since then. The increase in reports was largely due to a sharp rise in the number of acute transfusion reaction (ATR) reports, in parallel with the rise in total ATR reports. Paediatric ATRs are largely due to red cells and platelets, and there has been a steady increase in the number of febrile reactions since 2007. There has been less variation in numbers in other reporting categories and the number of special requirements not met (SRNM), a significant category of paediatric reports, has slightly decreased for irradiation/cytomegalovirus (CMV) negative reports. It is difficult to relate the reports to numbers of transfusions as there is little specific paediatric issues data. However, the stabilisation of overall numbers may indicate that current reporting rates are more representative of actual significant errors and events related to paediatric transfusion than in the past.

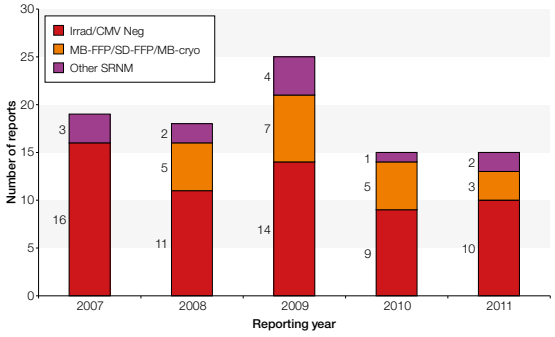
Figure 22.1 Trends in paediatric reports 2007-2011

a. Total numbers of paediatric reports

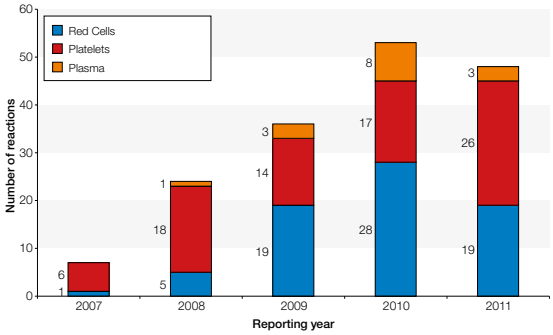


Note: in 2007 only cases < 16 years were included

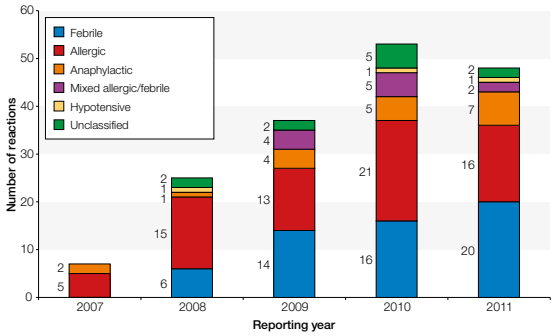
b. Paediatric SRNM reports



c. Paediatric ATR reports by component type



d. Paediatric ATR reports by reaction type

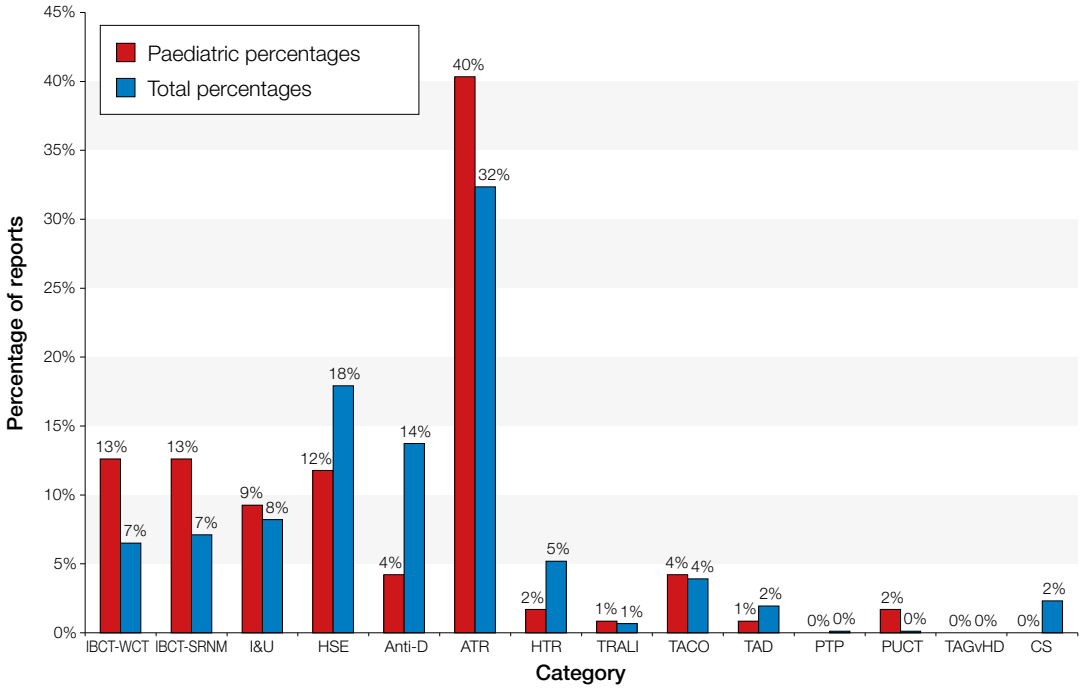


Note: 2008 anaphylactic reaction previously described as severe allergic

For 2011, paediatric reports were 119/1815(6.6%) of total SHOT reports, down compared to the last 3 years, from 8.8% in 2008, 8.6% in 2009 and 8.3% in 2010. If near miss (NM) and right blood right patient (RBRP) cases are included, paediatric reports were 219/3054 (7.2%). The number of paediatric reports is almost identical to last year, with a similar pattern of reports from different categories and age groups (Table 22.1, Figure 22.2). 50% (60/119) of paediatric reports were error-related (incorrect blood component transfused (IBCT), handling and storage errors (HSE), inappropriate, unnecessary or under/delayed (I&U) and anti-D), and errors were 73% (24/33) of reports in infants < 1 year. A total of 25/60 (42%) of paediatric errors originated primarily from the laboratory (21 IBCT, 2 HSE, 1 I&U, 1 anti-D), down from 32 in 2010. Laboratory errors were 21% (25/119) of all paediatric reports, compared to 26% in 2010. IBCT reports are twice the proportion of paediatric reports compared to SHOT reports as a whole (25% vs 14%), emphasising the importance of this category of errors in paediatric transfusion. ATR numbers were slightly down but reports of reactions to platelets had increased and were 55% of paediatric ATR (32% in 2010). Paediatric 'near miss' reports were significantly increased compared with 2010, probably due to changes in reporting patterns.

There were four paediatric deaths following transfusion, but only one was thought by the reporter to be possibly related to the transfusion, a neonate who developed necrotising enterocolitis (NEC), and causality is uncertain. There were 15 paediatric cases of major morbidity following transfusion, (10 ATR, 3 transfusion-associated circulatory overload (TACO), 1 transfusion related acute lung injury (TRALI), 1 PUCT).

Figure 22.2 Percentages of paediatric and total reports in each category (% numbers have been corrected to the nearest whole number)



Error-related reports n=60

Incorrect blood component transfused (IBCT) n=30

IBCT – Wrong component transfused (WCT) n=15

IBCT WCT – clinical n=4

There were 4 WCT reports resulting from predominantly clinical error. Two were for neonates of which one was transfused with adult emergency O RhD negative blood and another was given platelets when the staff had been intending to transfuse fresh frozen plasma (FFP).

Case 1

Baby given adult emergency O RhD negative blood

A preterm baby with hydrops fetalis required emergency transfusion following delivery. The baby was given adult emergency O RhD negative blood despite crossmatched blood being available within the maternity unit refrigerator following prior request by the obstetricians. The staff member who removed the emergency O RhD negative unit did this despite being told by a midwife that crossmatched blood was available. The baby died, unrelated to the transfusion.

A 2 year old who subsequently died was given red cells intended for her mother due to an error over identification of the different 'unknown females' in Accident and Emergency (A&E) following a major road traffic accident. A 14 year old after haemopoietic stem cell transplant (HSCT) was given RhD positive platelets despite having become RhD negative post-transplant when seen on a non-haematology ward and a new, incomplete, special requirements form was sent to the laboratory.

IBCT WCT - laboratory error n=11

There were 4 neonatal reports, three related to errors in neonatal and maternal grouping and antibody screening. For one, the mother had immune anti-D and a set of paedipacks was crossmatched against the mother, but a non-crossmatched set was issued. For 2 others, blood was issued with inadequate checking of maternal samples. Finally, there was incorrect recording of which packs of platelets were transfused to twins with neonatal alloimmune thrombocytopenia (NAITP). In the older age group, there were two reports where blood was inappropriately issued by electronic issue (EI): to an 8 month old following editing of a control well result on ABO grouping, and to a 9 year-old where it was overlooked that the patient had received a HSCT. There were 5 reports of RhD positive red cells being given to RhD negative recipients; 2 were females who were subsequently given anti-D Ig, with one of these having been incorrectly grouped using manual techniques. The other 3 were to male haematology/oncology patients.

IBCT- special requirements not met (SRNM) n=15

The number of SRNM reports was identical to 2010. Five were categorised as clinical error and 10 as laboratory. Non-irradiated components were erroneously given to 7 patients although there were no adverse consequences, and CMV negative to 4 (one with additional failure to irradiate). Two were given non-irradiated red cells post intrauterine transfusion (IUT) at approximately 3-4 weeks of age, one due to failure to notify the laboratory of an IUT at another hospital, and the other due to a laboratory failure to flag the requirement for irradiated blood post IUT. There were 4 other reports where clinicians either mistakenly informed the laboratory that irradiated or CMV negative components were no longer required or failed initially to request it, and 4 where the laboratory issued the incorrect component.

There were 3 cases where the laboratory did not issue MB-FFP to children <16 years, (from 2012 to be defined as those born after 1 January 1996) and 2 where the blood of an inappropriate phenotype was given including a K positive unit to a 17 year old female.

Inappropriate, unnecessary or under/delayed transfusion (I&U) n=11

The majority of paediatric I&U reports were not related to the recipients being paediatric. However, there were 3 cases of over-transfusion demonstrating poor paediatric prescription or administration. A neonate with bleeding was prescribed an incorrect volume of platelets, and two infants were overtransfused with red cells. For one infant the pump was set at too fast a rate for the first hour due an incorrect prescription of '1 unit'. For the other, a nurse gave the entire 200 mL volume of the red cell bag rather than the 100 mL prescribed due to thinking that red cell units are issued containing the requested transfusion volume.

There were 2 cases of delayed or under-transfusion. One was an under-transfusion of platelets to a 3 year old due to the issue of the incorrect volume. The second was a delayed urgent red cell transfusion for a symptomatic 16 year old with liver failure due to a misunderstanding by the night staff who left the transfusion for the morning shift.

Case 2

Confusion over platelet components

Platelets were requested for 3 year old child with thrombocytopenia post HSCT. Laboratory staff mistakenly ordered neonatal platelets and the bag supplied contained only 40mL despite the child having been prescribed 300mL. Platelets were transfused to the child and further platelets were ordered and administered the following day.

There were 6 cases where transfusions were given unnecessarily, due to poor communication or a lack of haematological advice. For 4, transfusions were given on the basis of the wrong result or where the transfusion had already been given. An 8 year old undergoing a laparotomy in theatre was transfused on the basis of an oxygen saturation result of '90' on a blood gas sample being misread as the Hb result (in fact '140'). An infant received a second transfusion of platelets because they were prescribed without checking first.

Case 3

Failure to check before prescribing that transfusion was indicated

A 2 month old baby on the neonatal intensive care unit (NICU) required platelets prior to surgery and the order for platelets was made twice. Following the first transfusion transfusion laboratory staff noticed the next day that platelets were still available but due to expire at midnight so informed the ward. This triggered staff to get the platelets to the ward on the assumption that they were required. On arrival the junior doctor was asked to prescribe the platelets. The infusion was discontinued when a senior doctor subsequently noticed that the baby was receiving platelets that were not required.

For 2 cases, the decision to transfuse was subsequently considered incorrect. Despite a local trigger of 11g/dL, a 16 year old with Diamond Blackfan Anaemia (congenital red cell aplasia) was transfused at a Hb of 12.2 g/dL in order not to waste the unit. A 17 year old with platelets of $66x10^9$/L and menorrhagia but no major bleeding was admitted and transfused platelets on the medical admissions unit, highlighted as inappropriate by haematological review for possible ITP the next day.

Handling and storage errors (HSE) n=14

The majority of HSE reports (10) were due to cold chain errors, 1 where the neonatal refrigerator was out of temperature range, and 9 where blood was out of controlled storage for longer than recommended in the British Committee for Standards in Haematology (BCSH) guidelines. 7 of these were due to slow red cell administration and 2 were due to a delay in setting up the transfusion. In one case a unit red cells was transfused to a child despite having been out of the blood refrigerator for 6 hours and having been set aside and marked as “out of cold chain” on the ward.

The other 4 cases were as follows:

Case 4

Slow transfusion due to incorrect administration set

Two hours after commencing a transfusion for a baby it was noted that only 2mL had been administered via the pump instead of the expected 14mL. The pump was replaced and the transfusion was recommenced. The transfusion finally finished after a total of 6.25 hrs. Later it was discovered that the pump malfunction was caused by using the wrong administration set.

There was 1 report of excessively rapid transfusion where a 6 month infant was transfused 41 mL over 20 minutes instead of 2 hrs due to an error setting the pump rate on a ward busy with many emergency admissions. In 2 reports expired units were transfused in theatre. 1 was of an infant undergoing cardiac surgery given FFP thawed for another patient 4 days earlier, and the other was of expired red cells transfused to 1 year old undergoing urgent neurosurgery; the red cells had not been recalled by the laboratory.

Anti-D Ig-related events n=5

The 5 cases were aged 15-17 where either the anti-D Ig was omitted or was given outside the 72 hr time limit. There was no clear indication that missing the anti-D Ig was related to young age.

Transfusion reactions n=59

Acute transfusion reactions (ATR) n=48

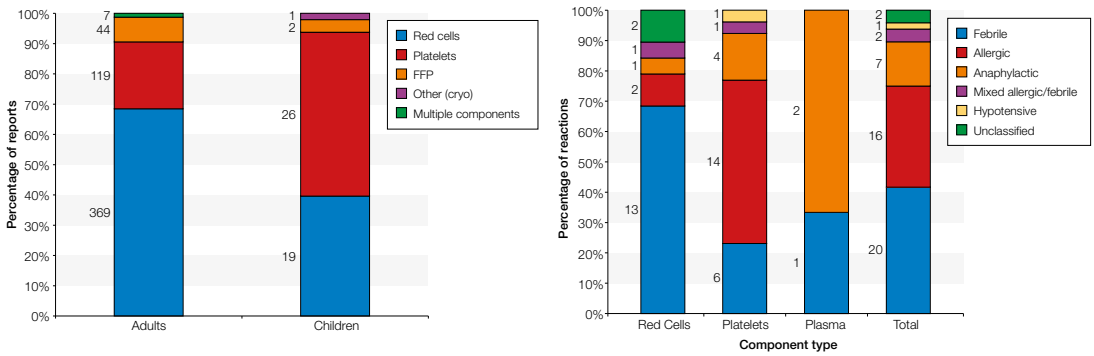
The number of paediatric ATR reports has fallen slightly to 48 from 53 in 2010. This is due to a reduction in the number of reactions to red cells and plasma (see Figure 22.1c). The number of platelet reactions increased from 17 to 26, which is 54% of paediatric ATRs (mostly to apheresis platelets) but although numbers of platelet reactions have fluctuated since 2007, they have represented a significant proportion of paediatric ATRs in all Annual SHOT Reports since 2007 when paediatric cases were first analysed separately. In 2011 only 1 reaction, a mild febrile reaction, was to MB-FFP, and there was an anaphylactic reaction to solvent-detergent FFP.

Paediatric ATRs are 8% (48/587) of all ATRs, but the pattern of reports to different components differs from that in adults (see Figure 22.3), with paediatric platelet ATR comprising 18% of all ATR to platelets, and a higher proportion of adult ATRs being to red cells.

Figure 22.3 Paediatric ATR reports

a. Comparison of proportions of adult and paediatric ATRs due to different components

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



As in previous years, most paediatric ATR were in the age group ≥ 1 year, with only 5/48 (10%) in infants <1 year, including 3 neonates. Neonatal reactions may be more difficult to recognise; one became febrile following FFP, another had an anaphylactic reaction to red cells following cardiac surgery with a rash and hypotension, and a third developed cardiorespiratory failure during red cell transfusion although the imputability was low.

The ATRs were classified as described in Chapter 13. Of the 46 that could be classified, 10 (22%) were severe, 21 (46%) were moderate, and 15 (33%) were mild. In all cases the patients recovered. There were 7 anaphylactic reactions in total (15% paediatric ATR), 1 following red cells to a neonate, 4 following platelets (1 pooled, 3 apheresis) to haematology/oncology patients aged 1-16 years, 1 following SD-FFP to an infant with a coagulation factor deficiency, and 1 following non-MB pooled cryoprecipitate transfused to a 14 year-old undergoing a spinal fusion. Anaphylaxis was reported in a higher proportion of events for paediatrics than for total ATR (33/587, 6%). The majority of paediatric red cell reports were febrile reactions, although febrile reactions occurred for all component types, whereas the majority of platelet reports were allergic.

Case 5

Severe reaction to solvent detergent-treated plasma (SD-FFP)

A male infant with a congenital coagulation deficiency received SD-FFP to treat a cerebral bleed, and experienced a severe anaphylactic reaction within 30 minutes of starting the transfusion, with tachycardia, hypoxia and hypotension. He required intubation and was given adrenaline. He was subsequently given MB-FFP to treat the continuing bleeding problems. On one occasion, his oxygen saturation dropped again, but otherwise he experienced no problems and he continues to receive MB-FFP without problems. Investigations for the cause of anaphylaxis proved negative.

From the reasons given by reporters at least 22/26 of the platelet transfusions, including all those with severe reactions, were given as prophylaxis for low counts rather than treatment of bleeding. Twelve of these were stated to be transfused to keep platelets >20 rather than >10 so these may have been patients with higher levels of intercurrent illness. Most ATRs related to platelet transfusions (23/26 recipients) occurred in patients under haematology/oncology care.

Table 22.2 Type of reaction for each component for paediatric reports (classified as in ATR Chapter 13)

Reaction	Red cells	Platelets	Plasma	Total
Febrile	13	6	1 (FFP)	20
Allergic	2	14	0	16
Anaphylactic	1	4	2 (1 SD-FFP, 1 Cryo)	7
Mixed febrile and allergic	1	1	0	2
Hypotensive	0	1	0	1
Unclassified	2	0	0	2
Total	**19**	**26**	**3**	**48**

HTR and alloimmunisation n=2

There no reports of paediatric HTR but there were 2 reports of alloimmunisation alone from patients aged 6 and 7 years with no evidence of haemolysis (see HTR Chapter 14). In one case Kp^a antibodies were detected 15 days post transfusion, and for the other, anti-Cw, anti-e, and anti-C were detected at 46 days. Neither were patients with haemoglobinopathies: one had chronic anaemia with 'pancytopenia' and one was transfused post chemotherapy for a glioma.

TRALI n=1

There was one report in a 16 year-old with respiratory deterioration post FFP. However, following investigation it was felt unlikely to be TRALI (see Chapter 15).

TACO n=5

There were 5 paediatric reports classed as TACO for the first time in 2011, with ages ranging from a neonate to 17 years. These involved 4 patients as one suffered two separate episodes.

Case 6

Transfusion given too fast

A 15 day old neonate on PICU was erroneously transfused with 53 mL red cells over 15 minutes rather than 4 hrs due to setting the infusion pump at an incorrect rate following an incorrect prescription. The baby required furosemide for mild circulatory overload.

A 1 year-old child became hypoxic after HSCT with evidence of pulmonary oedema on a chest x-ray during the first 2 hours post transfusion of '1 unit' of platelets over 1 hr and 156 mL blood over 2-3 hrs. A 7 year old transfused with a unit of red cells following major orthopaedic surgery desaturated 20 hrs later, requiring intubation and ventilation. A chest x-ray was suggestive of pulmonary oedema but the patient was hypotensive and also treated with fluids and inotropes, illustrating the difficulty in diagnosing TACO in complex cases. There were two separate reports from a 17 year old ventilated with acute renal failure. In the first episode acute respiratory deterioration followed crystalloid infusion followed by a cardiac arrest after transfusion of FFP. On the second occasion there was sudden respiratory deterioration following a 2 unit red cell transfusion and during a 1 unit platelet transfusion.

The last 2 reports illustrate how transfusion can destabilise patients who are already extremely unwell, and the event in the 1 year old illustrates the need for care over prescribing large volumes of blood components to small children.

TAD n=1

There was one report classified as TAD in a 6 year old with sickle cell disease whose oxygen saturation dropped from 99% to 93% 35 minutes into a red cell transfusion, although the child remained clinically well.

Post-transfusion purpura (PTP), transfusion-associated graft vs host disease (TA-GvHD), transfusion-transmitted infection (TTI), cell salvage and autologous transfusion (CS) n=0

There were no paediatric cases in these categories.

Previously Uncategorised Complications of Transfusion (PUCT) n=2

This year for the first time there were 2 cases with necrotising enterocolitis (NEC) possibly associated with red cell transfusion in 5-6 week old preterm infants. One died, and the other had major morbidity, requiring ventilation and bowel surgery. In one case, the abdominal symptoms commenced during the transfusion, and in the other several hours post-transfusion.

Case 7

Necrotising enterocolitis post transfusion

A clinically stable non-ventilated 6 week old preterm infant, born at 26 weeks gestation, was given a red cell transfusion for symptomatic anaemia of prematurity (Hb 9.3 g/dL). There were no adverse events during the transfusion, and the post Hb was 16.7 g/dL. 4.5 hrs post transfusion the baby developed tachycardia, and over the next 12 hours deteriorated and developed a distended abdomen. An X-ray was consistent with NEC, the baby continued to deteriorate and died at approximately 36 hrs post-transfusion.

This is an area of interest and concern for neonatologists. Several retrospective studies have reported an association between red blood cell transfusions and subsequent necrotising enterocolitis (NEC) in neonates occurring up to 48 hrs post transfusion, particularly in preterm babies who develop NEC at around 3-5 weeks of age[72]. It has been suggested that transfusion-associated NEC could have parallels with TRALI[73]. However, the pathogenesis of transfusion-associated NEC is not clear, and prospective studies are required to further investigate a causal relationship.

Near miss events n=89

Near miss reports increased significantly from 41 in 2010 to 89 in 2011. Forty events occurred in infants < 1 year, and included 5 where there was WBIT or incorrect labelling due to confusion between twins. Three neonates had maternal details on the sample tube, and in other 2 cases correct procedures for neonatal blood grouping and antibody screens were not followed in the laboratory. Most of the other cases were not specifically paediatric related (see Chapter 25 for further discussion).

Right Blood Right Patient events n=11

Two of the RBRP cases affecting infants <1 year old involved misallocation/mislabelling of multiple split packs, FFP in one case and red cells in the other.

COMMENTARY AND LEARNING POINTS

- The number of paediatric reports is stable since 2010, and the number of laboratory errors has shown a slight decrease.
- Many of the paediatric reports highlight the same issues as in previous years, including use of adult emergency O RhD negative blood for neonates, laboratory errors in neonatal and maternal grouping and antibody screening, failure to recognise the need for irradiated components post IUT, and prescription and administration errors leading to either overtransfusion or the incorrect rate of transfusion.
- Poor communication and lack of checking were significant features of the I&U cases with poor clinical understanding of the transfusion process in paediatrics, including the need to administer a specific volume in mL based on body weight rather than in ‘units’.
- Neonatal components were associated with errors either from confusion over the volume being incorrect for the age/weight of the child, or with different split units being mislabelled or assigned to the wrong patient.
- Children were reported to have suffered transfusion-associated circulatory overload for the first time, illustrating the importance of prescribing the correct volume and rate for small infants and children.
- There were two reports of NEC associated with transfusion, but without further evidence of a causal association it is difficult to assign imputability beyond ‘possible’ for these. Prospective studies are needed to further investigate this association. SHOT requests that hospitals continue to report cases of possible transfusion-associated NEC in order to provide more representative information on the nature and extent of this possible reaction in the UK. There has been some suggestion that the age of red cells transfused may be important, and it would be helpful to have this information in any reports.
- There continue to be a significant proportion of ATRs following paediatric platelet transfusion, including 4 anaphylactic reactions. As the majority of the platelet transfusions were reported as given for prophylaxis rather than bleeding, this emphasises the need to ensure that prophylactic platelet transfusions are given according to guidelines, particularly as the recent National Comparative audit of platelet transfusions in haematology[74] found that many prophylactic platelet transfusions were inappropriate.

Recommendations

- A significant number of paediatric acute transfusion reactions (ATRs) followed prophylactic platelet transfusions; this underlines that it is important to ensure that prophylactic platelets are given according to guidelines[43].

  Action: Hospital Transfusion Teams (HTTs), clinical users of blood

- Paediatric ATRs where there are severe allergic reactions should be investigated in conjunction with allergy specialists (British Committee for Standards in Haematology (BCSH) ATR guidelines in preparation)[13].

  Action HTTs and haematologists

- SHOT requests that hospitals continue to report cases of possible transfusion-associated necrotising enterocolitis (NEC) in order to provide more representative information on the nature and extent of this possible reaction in the UK.

  Action: HTTs and clinical users of blood

For active recommendations from previous years and an update on their progress, please refer to the SHOT website