Avoidable, Delayed and Under or Overtransfusion (ADU) n=225

(n=246 in 2016)

11

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Overview

- Avoidable transfusion n=101 (near miss n=10)
- Delayed transfusion n=95 (near miss n=1)
- Under or overtransfusion n=24 (near miss n=1)
- Cases related to prothrombin complex concentrate (PCC) n=5

11a Delayed Transfusion n=95

Definition:

Where a transfusion of blood/blood component was clinically indicated but was not undertaken or non-availability of blood components led to a delay with impact on patient care (not restricted to emergency transfusion).

Delays in transfusion of patients with antibodies

One death (Case 11a.1) and 2 other cases of delay (Cases 11a.7 and 11a.9 below) were caused by the presence of antibodies.

Key SHOT messages

- Guidelines must not be oversimplified and made into rules. While it may be safer not to transfuse at night, the patient's clinical need for transfusion must override this (Bolton-Maggs et al. 2014). However, transfusion should not be undertaken without adequate trained staff on duty to monitor the patient and react appropriately to any complications, and this would be particularly important at night
- Desire to follow good transfusion practice in some areas, if taken out of context, may risk patient death or morbidity due to delays in transfusion in major haemorrhage scenarios. This includes withholding any blood when the patient's antibody screen is positive, but antibody identification is not yet completed:
  - There are safety concerns regarding a possible delayed haemolytic transfusion reaction (DHTR) due to an antibody (with poor haemoglobin (Hb) increment, jaundice and renal failure) but if clinical harm to patients from withholding blood outweighs these, then emergency blood is essential and should be offered. Patients should not die from lack of blood
  - If antibody investigations have not been completed, or the patient has known antibodies for which compatible blood is not readily available:
    - ABO-, full Rh- and K-matched blood may be given, with intravenous (IV) methylprednisolone 1g and/or IV immunoglobulin (Ig) cover if required
    - Discuss with a clinical haematologist regarding the need for IV methylprednisolone and/or IVIg and monitoring for DHTR (including urine output), in light of any alloantibodies subsequently identified, and if any incompatible blood has been transfused
    - If full Rh and K phenotypes are not known, give ABO- and D-matched blood, with cover as above; if ABO and D groups not known, give O D-negative blood (or O D-positive blood may be given to males and post-menopausal women) with cover as above

For further key messages on delays in massive haemorrhage, see SHOT Bite No. 8 www.shotuk.org/resources/current-resources/.

Delays are often additive since there are several points in the transfusion pathway where there may be hold-ups. These are illustrated in Figure 11a.4.

Overview

Delayed transfusion was reported for 95 patients, age range newborn to 100 years (median age 30 years); 49 were female and 45 male (1 not specified). There was 1 near miss delay related to laboratory testing.

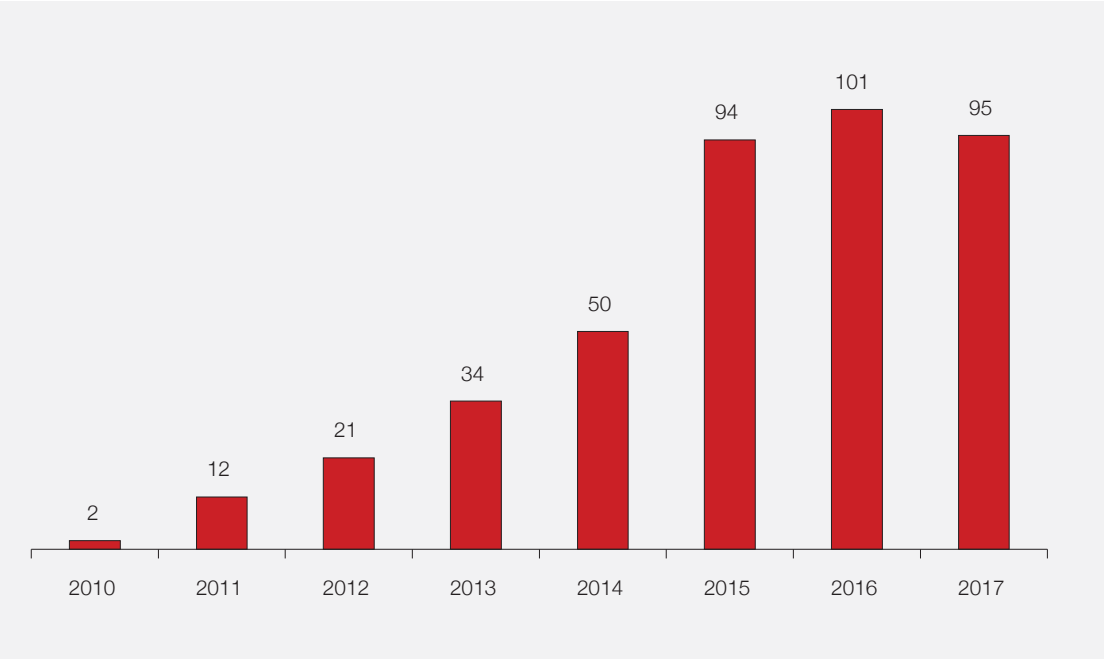


Figure 11a.1: Delayed transfusion reports by year 2010-2017

Figure11a.2: Urgency of delayed transfusions n=95

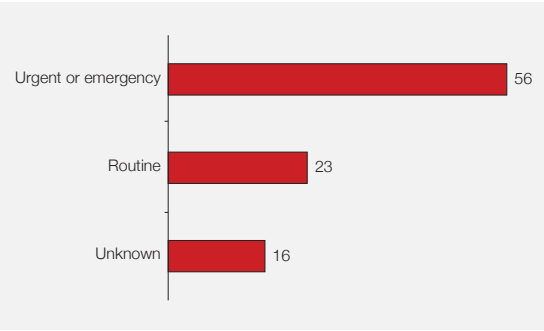
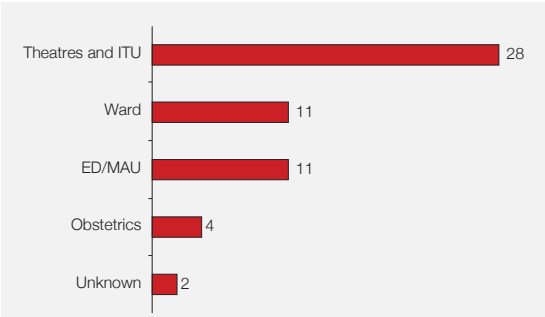
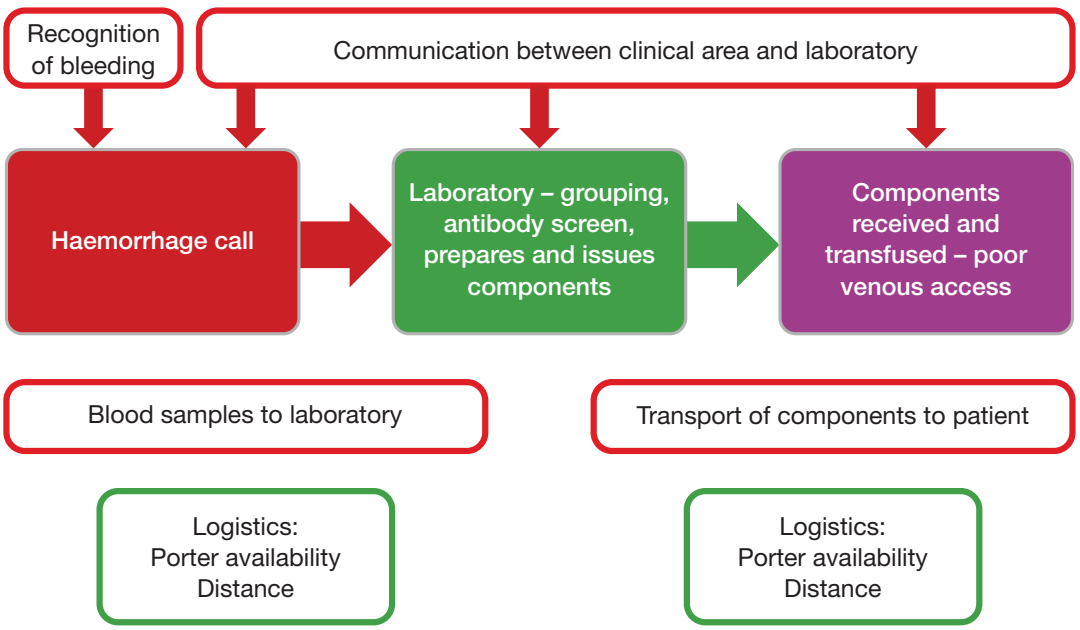


Figure 11a.3: Location of emergency and urgent transfusions n=56



ED=emergency department; MAU=medical admissions unit; ITU=intensive therapy unit (all types)

Figure 11a.4: Potential hold-up points in the transfusion pathway



Deaths n=6

Overall 14 deaths were reported. One death was directly attributable to the delay. Three deaths probably resulted from delayed transfusion and in 2 there was a possible relationship. Eight deaths were not thought to be related to the delay in transfusion.

Table 11a.1: Relationship of transfusion priority to deaths in delayed transfusions

	Imputability				
Transfusion priority	Definite	Probable	Possible	Unrelated	Total
Emergency	0	2	1	4	**7**
Urgent	1	0	1	2	**4**
Routine	0	1	0	0	**1**
Unknown	0	0	0	2	**2**
Total	**1**	**3**	**2**	**8**	**14**

Death definitely related to delay n=1

Case 11a.1: Death as a result of delayed transfusion for autoimmune haemolytic anaemia

A man in his 60s presented with Hb 38g/L secondary to autoimmune haemolytic anaemia (AIHA). The hospital laboratory referred the sample to an external reference laboratory (2 hours away) for further analysis due to the presence of a strong pan-reactive autoantibody. The patient died before the results were issued and without receiving any red cells. There had been an opportunity for a group and screen (G&S) sample to be sent a day earlier when the patient first presented. It was noted that there was no haematology consultant on site overseeing the patient's care out-of-hours due to centralisation of specialist services.

A G&S sample should have been sent at the earliest opportunity in anticipation of difficulties that would be encountered with full serological compatibility testing in a patient with AIHA. AIHA is caused by an autoantibody which reacts against non-specific red cell antigens. The presence of a pan-reactive autoantibody can mask additional alloimmune antibodies and therefore extended (and time-consuming) testing is required to exclude or identify these.

The mainstay of treatment for AIHA is immune suppression avoiding transfusion unless absolutely necessary. In cases with life-threatening anaemia blood transfusion is necessary and may be lifesaving. The primary risk of transfusing a patient without the results of an alloantibody panel would be the potential for a haemolytic transfusion reaction if a clinically significant alloantibody is present. When

anaemia is life-threatening, transfusion with ABO-, full Rh- and K-matched blood is more appropriate than delaying until full serological investigations have been completed (BSH Hill et al. 2017). Incompatible red cells may be transfused where the anaemia is life-threatening. Alert the transfusion laboratory staff early when transfusion may be required for patients with irregular antibodies. Where incompatible red cells are transfused, monitor the patient carefully, including renal function and urine output, and consider use of IVIg (see also Chapter 19, Haemolytic Transfusion Reactions (HTR), 3 cases).

Deaths probably related to delay n=3

Case 11a.2: Delayed transfusion contributes to death from haematemesis

A non-English-speaking man in his 40s with a history of alcohol dependence, hepatitis C and substance misuse (on a methadone programme) attended the ED with haematemesis after a 999 call by his friends at 03:20. The patient was not triaged appropriately (ambulance records of vomiting blood, pulse 130 beats per minute (bpm), blood pressure (BP) 94/60mm Hg) and his clinical state was not monitored adequately in accordance with hospital guidelines (no hourly observations and no early warning score monitoring). He should have been seen within 10 minutes but was seen after 1.5 hours. At 04:28 the Hb was 56g/L. The laboratory contacted the ED to report this result and later at 05:45 to offer emergency O D-negative blood. This advice was declined and fully crossmatched red cells were requested at 05:09 with 'routine' priority. The patient's clinical deterioration was not detected by nursing or clinical staff. The major haemorrhage protocol (MHP) was not activated.

The patient died at 08:06 following cardiac arrest with further large haematemesis and melaena prior to receiving any blood components.

Poor clinical judgement by both nursing and medical staff was noted with failure to recognise the severity of the patient's clinical state and failure to activate the MHP. These contributed to the death of the patient. Hospital procedures were not followed and it was noted on review that both the doctor and nurse involved in the case were agency staff (3/7 nurses were agency staff) and therefore not required to attend mandatory training. The medical and nursing shifts changed over at 07:00 so that the patient was seen by a succession of different staff. The case review resulted in improved arrangements for orientation for agency staff to ensure that the correct triage procedures are followed.

Case 11a.3: Delayed transfusion for severe anaemia related to gastrointestinal (GI) haemorrhage contributes to death

A man in his 70s presented with a 2-day history of bilateral leg pain and was found to have a Hb of 49g/L at 08:00. He had multiple comorbidities including a history of angiodysplasia and ischaemic heart disease with multiple stents with atrial fibrillation for which he was on aspirin and rivaroxaban. Blood was requested (although the first sample was rejected due to incorrect date of birth) and available for collection at 11:49. The plan (at 13:54) was to transfuse to Hb >90g/L cautiously given a high risk of transfusion-associated circulatory overload (TACO).

However, the patient was not transfused until the following day, when found unresponsive with an unrecordable BP, metabolic acidosis and Hb 34g/L. He was transfused four units of red cells (post-transfusion Hb 73g/L) and three units of fresh frozen plasma (FFP) (international normalised ratio (INR) >2.5) and admitted to the ITU. The patient died 24 hours after admission from cardiogenic shock related to profound anaemia in the context of cardiomyopathy.

There was a delay of more than 18 hours from the decision to transfuse. The incident report noted that there were concerns about transfusing the patient while in transit between wards and transfusing overnight but there was also evidence of poor handover at several points and excessive workload for junior doctors leading to lack of clinical review and documentation overnight. Concerns regarding TACO were valid but should have been overcome with close monitoring and use of diuretics if required. It was also noted in the case review that pressures to meet waiting targets in the ED may have led to an initial delay. It may have been appropriate for the patient to have received part of the planned transfusion prior to moving to the medical ward, regardless of targets. There were several recommendations for change in practice as a result including transfer checklist from ED to ward, teaching on transfusion to medical and nursing staff, a review of overnight medical cover and the importance of good handover.

Learning point

- A patient should not die from anaemia. The guidance to not transfuse at night has been translated into a rule which it is not. Patients may need urgent transfusion at any time in 24 hours and this should not be delayed

Case 11a.4: Access to the laboratory refrigerator contributed to delay in provision of emergency blood

A man in his 60s, managed on ITU for ongoing variceal bleeding, deteriorated acutely with a further massive haemorrhage. Two units were issued at 02:56, the first was collected at 03:31. He became unstable with resistance to fluids and two units of red cells. The MHP was activated at 03:38; units were available by 03:47 but it took 36 minutes for further red cell units to reach the ward. The patient was profoundly hypotensive throughout this period and was not suitable for resuscitation by the time the blood components arrived.

Several problems contributed to the delay: a reduced number of porters, distance and problems with the issue refrigerator. The main issue refrigerator was awaiting repair and the blood was stored in another refrigerator in the laboratory requiring additional steps to access blood that would not have occurred if the main issue refrigerator was in operation. The procedural review recommended an increase in porters and giving them access codes for the laboratory. A designated cool box was made available for immediate collection. The review also noted that there was delay in implementation of barcoded identification bands due to funding issues.

Death possibly related to delay n=2

Case 11a.5: Failure to follow MHP correctly contributes to delay and death

A man in his 80s was admitted to the ED with massive haemorrhage (no further details). The MHP was activated. Emergency O D-negative units and pre-thawed FFP were available and issued for use by the laboratory in a timely manner. The blood components were available to collect but the clinical staff were not aware of this and another doctor contacted the laboratory 20 minutes after the components had been issued. The patient was then transferred to the radiology department but the components were delivered to the ED. The patient died the same day.

Poor communication and lack of understanding of the MHP led to delays in transfusion that possibly contributed to this patient's death. MHP drills and retraining have been implemented in the ED as a result of this incident. In a second case suboptimal communication between laboratory and clinical staff led to a 2-hour delay in transfusion after activation of the MHP in association with the laboratory information management system being down for a long period.

Major morbidity n=1

In 1 case delayed transfusion was a contributory factor to major morbidity.

Case 11a.6: Delayed transfusion in a patient with cardiac ischaemia contributes to major morbidity

A man in his 50s was admitted from the endoscopy unit with chest pain confirmed due to non-ST-elevation myocardial infarction (NSTEMI). The Hb was 43g/L at 10:45 (he had a previous history of GI bleeding). At 13:37 red cells were available for collection but were not transfused until 16:25. The reason for the delay is unclear, although there was likely inadequate communication as a contributory factor. The patient was admitted to ITU and made a full recovery.

It is uncertain whether failure to recognise the severity of the patient's condition, or lack of clarity as to the urgency of transfusion, caused the delay in this case. Patients with cardiac chest pain should have their anaemia managed as a matter of urgency.

In the following case a patient was put at risk of serious harm due to delay.

Case 11a.7: Delayed transfusion in a patient with chest pain due to lack of knowledge about how to manage critical anaemia in the presence of pan-reactive antibodies

A woman in her 50s with chronic significant gynaecological haemorrhage was admitted from clinic with Hb 56g/L at 16:00. She was clinically stable. A G&S sample was not sent until 08:58 the following morning. She was found to have a pan-reactive antibody which required further testing and the sample was sent to the local external reference laboratory. At 14:00 the patient became acutely unwell with crushing central chest pain and a respiratory rate >40 breaths per minute (/min), thought to be secondary to cardiac ischaemia. A repeat blood count showed Hb 46g/L. Blood was not available until 17:00, 3 hours after the development of cardiac symptoms.

This case demonstrates several areas for improvement. There should not have been a lengthy delay sending transfusion samples, particularly in a patient considered high enough risk to warrant inpatient admission. There was failure to communicate the change in the patient's clinical status, and urgency of blood requirement, to the laboratory. The sample had been sent to the reference laboratory as a 'routine' case as had the delivery of blood components 'when available'. This is another instance where the patient could have received ABO group-specific, full Rh- and K-matched red cells when it became apparent there was going to be delay. The risk of leaving a severely anaemic patient with cardiac chest pain is likely higher than the risk of transfusing blood with a potential alloantibody.

Delays involving the management of MHP n=19

Poor communication was a common cause of delays. There were logistical issues in notifying laboratories of activation of the MHP in 5 cases and 4 further cases in which porters were not alerted. It is essential that there are dedicated lines of communication to the transfusion laboratory and that porters are included in the alert and updated as to any changes in patient location (Case 11a.5 above: death possibly related to delay).

Case 11a.8: Wrong patient details supplied to laboratory in a major obstetric haemorrhage

A woman in her 20s had a postpartum haemorrhage leading to MHP activation. The midwife gave the wrong patient details to the laboratory staff which was not recognised until the red cells (incompatible ABO group) arrived in the maternity unit. They were returned and correct details applied but this resulted in a 25-minute delay to provision for the group O patient.

The review noted that this was an unusually busy evening with complicated cases causing demands of the staff and service. The error was detected because of correct checking processes prior to transfusion.

Case 11a.9: Lack of knowledge about emergency blood provision in patients with alloantibodies leads to delayed transfusion

A man in his 50s with variceal haemorrhage related to alcoholic liver disease was admitted to the ED. A MHP call was instigated at 01:40. The patient had alloantibodies, anti-K and anti-C^w. The biomedical scientist (BMS) was reluctant to issue the shock pack (four units of red cells and four of FFP) and informed the ED not to use the emergency O D-negative blood in the local refrigerator. A consultant haematologist was contacted 25 minutes after the MHP call and authorised the transfusion. Blood was collected at 02:16. The patient was admitted to ITU and eventually made a full recovery.

An unnecessary delay in issuing emergency blood components resulted from a lack of knowledge by the BMS, who was working alone at night, and failure to follow the standard operating procedure (SOP) for patients with known irregular antibodies (to issue group O K-negative units and immediately contact the haematologist on call).

Case 11a.10: Change in status of the patient and poor communication compound the delay

A young man was admitted with trauma from a road traffic accident with closing speed of 70 miles per hour. He was initially stable; four units of blood were requested urgently to be available at 18:55. The BMS acknowledged that these would be available in 10 minutes. However, the blood sample was not taken until 19:00, was booked into the laboratory at 19:20 but had to be reprocessed at 19:47 as the antibody screen had not been done. During computerised tomography (CT) scanning the patient started to deteriorate with an increase in pulse rate to 135 beats/min such that the internal bleeding was now thought to be greater than it seemed at first.

A porter was sent to collect the blood and a telephone request was made for platelets and plasma as indicated by thromboelastogram (TEG) testing. Although there was an agreed TEG protocol in place for a 1:1 red cells to plasma ratio the BMS noted that this request would require authorisation by the haematology registrar (as this had not triggered the MHP). The BMS did not inform the ED staff that there had been a problem with the antibody screen. The MHP was called at 20:37 when blood and plasma were issued and collected. Plasma was infused at 21:15 and platelets at 22:15. The ED staff could have used the emergency O D-negative units.

This case demonstrates that it may be difficult to determine the severity of bleeding in closed injuries. If there is a change in urgency for blood component delivery this should be clearly communicated to the transfusion laboratory staff; the BMS is likely to have had several actions in progress and will need to know if the priority has changed. It would be normal practice to require haematology authorisation for platelets requests but not once the MHP has been activated. The outcome of the case was to ensure that communication between the ED and transfusion laboratory is clear and concise.

Case 11a.11: Telephone check prior to high risk surgery detects failure of process

A woman was scheduled for elective caesarean section for placenta praevia; blood samples were sent for group and crossmatch four units of red cells 2 days prior to the procedure. At the time of surgery, after the spinal anaesthetic had been placed, a telephone call to the laboratory established that no units were available due to a laboratory error in processing the request. The request form had been put in the wrong location for crossmatch requests at the time of a shift changeover. The four units were made available within 40 minutes. The start of surgery was delayed but the red cells were not used.

Preparation for surgery where blood loss is high risk requires red cells to be available at the time of surgery. It was fortunate that the staff chose to check prior to starting the surgery in this case.

Information technology (IT)-related delayed transfusions n=11

Equipment failure n=2

In one case the printers failed and then blood components issued manually were returned due to a transcription error. In another the MHP was not correctly activated because the bleeps do not work throughout the hospital.

Electronic blood management systems (EBMS) n=7

In all 7 cases blood could not be accessed from a satellite refrigerator under the control of an electronic blood management system and this caused delay in 6 emergencies and 1 urgent clinical situation.

Case 11a.12: Refrigerator incorrectly stocked for remote electronic issue (EI)

Two high-risk cases, both blood group A, were anticipated to require significant amounts of blood during surgery. The group A drawer of a remote electronic issue refrigerator was full so additional units were put in the 'crossmatched blood' drawer. As expected the group A blood was rapidly depleted and the clinicians were warned by the EBMS that the supplies were low. However, the BMS viewing the stocks remotely could see that there were plenty of group A units remaining. These were not available for remote electronic issue and had to be issued from the laboratory.

In two critical situations where blood was required immediately, the clinical staff removing blood from the satellite refrigerator did so incorrectly. In one case all the units were scanned out at the same time and became 'invalid' for use so had to be reissued from the laboratory causing delay. On the other occasion neonatal emergency blood was required. The first collector used the wrong programme so a second trained operator removed the blood correctly but left the refrigerator drawer and door open. The process was therefore incomplete and no further blood could be safely removed without intervention from the laboratory.

In two other cases blood was not available because the refrigerator locked closed. This was as a result of a motherboard failure in one and because the screen froze on the kiosk in another. Downtime procedures were available, but were not always followed immediately.

Training is essential for all EBMS operation and training against routine and emergency procedures could have prevented all the cases mentioned above. Training is particularly important during implementation of a new system and when new staff join the organisation. There was one delay because porters did not have the necessary barcodes to collect blood and another because there were both new and old systems in place during a transition to an EBMS and the completion of two collection processes caused unacceptable delay.

Others n=2

In one case a laboratory information management system (LIMS) flag stating the need for a serological crossmatch was not heeded.

In another case there was a delay to transfusion, and to transfer to a specialist unit, because methylene-blue-treated FFP could not be issued to a neonate. The component choice (and component code) had not been set up on the LIMS so this had to be issued manually.

References

Bolton-Maggs PHB, Poles D et al. on behalf of the SHOT Steering Group. The 2014 Annual SHOT Report (2015) www.shotuk.org pages 26-27.

BSH Hill Q A, Stamps R et al. Guidelines on the management of drug-induced immune and secondary autoimmune, haemolytic anaemia. *Br J Haematol* 2017;**177(2):** 208-220.

11b Avoidable Transfusion n=101

Definition:

Where the intended transfusion is carried out, the blood/blood component is suitable for transfusion and compatible with the patient, but where the decision leading to the transfusion is flawed. This includes transfusions based on poor knowledge, communication failures, incorrect decisions or poor prescribing.

In addition to the total above, 2 delayed transfusions resulted in inappropriate use of O D-negative units and 1 case of undertransfusion was a result of transfusion of a low volume of FFP that was also inappropriate (not indicated for reversal of rivaroxaban). These are counted in their own sections (giving an overall total of 104). Two avoidable infusions of PCC are included in the PCC section.

Overview

No serious harm was known to have occurred as a result of avoidable transfusion, although there was one episode of probable transfusion-associated circulatory overload (TACO) reported in association with an avoidable transfusion and additionally reported in TACO. Four deaths occurred in this group, none of which were related to the transfusion.

Sample errors n=29

Blood component prescriptions based on the wrong blood results accounted for a third of avoidable transfusions.

Table 11b.1: Causes of wrong blood results n=29

Error	Number of cases
Result from another patient used	8
Dilute sample (drip arm)	5
Clotted sample	2
Transcription error	2
Historical results reviewed	3
Erroneous near-patient-testing results	1
Other	6
Laboratory error: platelet clumps	1
Erroneous platelet count from WBIT	1
Total	**29**

WBIT=wrong blood in tube

Case 11b.1: WBIT with failure to verify unexpected results

A nursing home resident in her 70s was reviewed in the community. A blood sample taken by the general practitioner (GP) showed a platelet count of 6x10^9/L with a white cell count of 1.98x10^9/L. She was admitted to hospital later that day for a platelet transfusion. Blood sampling was repeated on arrival to hospital prior to transfusion; the platelet count was 186x10^9/L and white blood count was 11.7x10^9/L. These results were not reviewed by the admitting doctor and a unit of platelets was prescribed and administered. The error was detected by laboratory staff.

This primary error in blood sampling caused unnecessary admission to hospital for an elderly patient and exposure to a blood component that was not indicated. However, a series of events contributed to this outcome. Firstly, the report noted that the sample was taken from another patient in the nursing home. Initial patient identification, if performed correctly, would have prevented this. The results should then have been reviewed by the GP and admitting doctors. If these results were unexpected, based on the patient's symptoms and previous trends (if available), then investigation into the abnormal results is required. This should include consideration of an erroneous result and thorough clinical investigation. This should occur prior to transfusion unless the patient is at high risk due to significant active bleeding. In this case a repeat sample was requested and a normal platelet count demonstrated. There was failure to review the most contemporaneous results prior to authorising a transfusion. There were at least four errors in procedure.

Case 11b.2: Poor management leads to excessive transfusion

An elderly man required a revision hip replacement (40-year-old prosthesis). At preoperative assessment a week before surgery his Hb was 127g/L. He bled during the technically difficult and long procedure (about 5 hours) and received six units of red cells before the Hb was checked and found to be 170g/L.

The review noted reliance on estimated blood loss as an indicator for transfusion, an 'I know best' attitude and a loss of situational awareness. Preoperative preparation was suboptimal. The patient did not have an arterial line nor central venous access and was lying on his side for the surgery which meant that only one arm was accessible for blood sampling.

Inappropriate management of haematinic deficiency n=10

There were 8 cases where patients with iron deficiency anaemia were treated inappropriately with blood transfusion. A further case was identified in the overtransfusion category (Case 11c.4). One patient was transfused for folate deficiency and 1 for B12 deficiency.

Case 11b.3: Inappropriate transfusion in a patient with iron deficiency and failure to check response to transfusion

A woman in her 50s with iron deficiency anaemia and Hb of 57g/L presented with fatigue as her only symptom. She weighed 54kg and was prescribed a five-unit red cell transfusion by a junior doctor. All five units were transfused with a repeat full blood count (FBC) only checked after the fifth unit had been given. The post-transfusion Hb was 131g/L.

This patient was exposed to risks of transfusion, and in particular TACO, due to an unnecessary transfusion that was also inadequately monitored. Given that this patient was relatively asymptomatic with no cardiovascular risk factors, a more considered approach may have been to transfuse one unit of red cells at most, with repeat clinical assessment afterwards. A course of oral or intravenous iron would be appropriate management.

Investigation into to the underlying cause of iron deficiency is also required.

Case 11b.4: Perioperative transfusion of red cells due to failure to manage iron deficiency anaemia preoperatively

A man in his 70s was found to be iron deficient 6 months prior to an elective abdominal aortic aneurysm repair (AAA). The iron deficiency was not managed adequately. Preoperatively, the Hb was 106g/L but it was felt that surgery could not be deferred. The Hb fell to 83g/L following the procedure and four units of red cells were transfused.

Preoperative anaemia is associated with increased postoperative morbidity and mortality, and increased transfusion needs. National Institute for Health and Care Excellence (NICE) guidelines on blood transfusion recommend treating iron deficiency with iron supplements (NICE 2015). Hospitals should design pathways to manage these patients effectively.

Potentially avoidable use of emergency O D-negative units n=17

Seventeen cases have been identified when emergency O D-negative units were issued inappropriately. Five emergency or urgent transfusions were in the ED, 2 in the delivery ward, and 2 in theatre. Other locations included the medical admissions unit and wards. Two additional cases are included where delays resulted in inappropriate use; in both instances there was delayed provision of crossmatched red cells due to an earlier error with pre-transfusion compatibility testing. This is a waste of a precious resource and moreover, O D-negative red cells are unsuitable and potentially unsafe for certain patients, e.g. those with anti-c antibodies.

Table 11b.2: Reasons for use of emergency O D-negative units

Avoidable use of emergency O D-negative units	Number of cases
O D-negative used when crossmatched available	4*
O D-negative used when group-specific available	1
Delayed provision of correct components due to earlier error	9
O D-negative blood used in non-emergency scenario	3
Total	**17**

**In 1 case EI could have been used to issue crossmatched units if historical records had been checked*

In 9 cases, emergency O D-negative red cells were issued because of earlier errors. These included: labelling errors (n=2), failure to notify the laboratory to convert group and screen to a crossmatch request (n=1), samples misplaced in laboratory (n=2), delays sending samples to the laboratory (n=3), failure of laboratory staff to check if EI was appropriate (n=2) resulting in delays due to unnecessary requests for repeat sample testing, and delays in processing samples that were not required. In some cases, more than one error occurred.

Case 11b.5: Delayed provision of red cells for postpartum haemorrhage caused by miscommunication by the clinical team and failure to check sample validity in the laboratory

A young woman had an estimated 3.6L blood loss from a vascular tear following vacuum-assisted vaginal delivery at 07:45. A valid sample was available for EI from the previous day. Two litres of fluid were infused and another transfusion sample was sent to the laboratory at 08:00 with a request for two units of red cells to be crossmatched. The urgency of the request was not conveyed to the laboratory. The laboratory staff then failed to check for sample availability and therefore unnecessarily processed the new sample. This caused additional delay, preventing EI from the existing sample. Crossmatched blood was issued at 09:22 after one unit of emergency O D-negative blood had been transfused at 08:30.

Clear communication is vital. It is essential to inform the laboratory when blood is required urgently. The laboratory should check for availability of a valid sample. In this case group-specific blood could have been issued.

Inappropriate transfusion of FFP n=6; given to reverse anticoagulant effect n=3

FFP was given inappropriately to three patients to reverse anticoagulant effect. One woman in her 70s on warfarin with INR 3.7 developed a rectus sheath haematoma. PCC should be used in emergencies to reverse warfarin together with vitamin K. There is no role for FFP. Two patients were anticoagulated with rivaroxaban, and while there is as yet no licensed reversal agent current guidelines recommend the use of PCC in emergency situations. In one of these cases, the dose of FFP was also inadequate (counted in the undertransfusion category) and would have had little therapeutic benefit even in an appropriate situation.

Case 11b.6: Unexpected severely abnormal results should be checked prior to release by the laboratory

A man with alcoholic liver disease undergoing surgery was reported to have INR >11 with an abnormal fibrinogen result and was transfused FFP and cryoprecipitate on the basis of this result which should have been repeated by the laboratory.

Learning point

- Laboratory staff should not issue results which they know or suspect to be unreliable or incorrect

Case 11b.7: Avoidable transfusion of FFP associated with poor communication and the distance of surgical treatment centre from transfusion laboratory

A patient at a local treatment centre (TC) (12 miles away) was bleeding following emergency evacuation of a haematoma two weeks following a hip replacement. This emergency surgery took place at a weekend. The patient required four units of group O D-negative red cells. There was no group and screen sample at the main hospital as the procedure was considered low risk for bleeding (the TC keeps O D-negative red cells as stock).

At 12:00 a request for FFP was referred to the on-call consultant haematologist who advised that due to the clinical situation and distance two units of plasma should be thawed and sent. He also requested that FBC and clotting samples were taken as soon as possible, but there was a significant delay in taking these samples. At 14:00 the consultant haematologist was contacted by the anaesthetist to inform him that the patient was in recovery, and was now 'haemodynamically stable' although hypotensive with a tachycardia. Four units of red cells had been transfused. The haematologist advised that given this information and in the absence of the clotting results that the previously authorised FFP be transfused. At 15:30 the clotting results (all parameters within normal limits) were telephoned to the haematologist but not conveyed to the TC. Although no further red cells were transfused two units of FFP were transfused, at 17:30 and 18:00, despite the patient being stable and 2 hours after clotting results were available showing normal parameters.

This was the first occasion that staff at the TC had to manage a major bleed (pathology services supplied offsite since 2012) and resulted in review and revision of their major haemorrhage protocols to include management of major haemorrhage at a site which is 12 miles away from the supplying transfusion laboratory. There may be more issues similar to this with the proposed centralisation of pathology services in an expanded number of hub and spoke models.

Inappropriate transfusion of platelets n=15: make a diagnosis before ordering platelets

Platelets were issued on the basis of erroneous results n=6: 2/6 as result of WBIT, 3/6 due to platelet clumping, 1/6 cause unknown.

One patient received platelets for a low platelet count that was later diagnosed to be due to thrombotic thrombocytopenic purpura (TTP). This is a thrombotic condition in which platelet transfusions are contraindicated except for life-threatening bleeding as they may increase the risk of thrombosis. This illustrates the importance of establishing the cause of thrombocytopenia prior to transfusion. Early review of a blood film is essential for assessment of unexpected thrombocytopenia and may have established this diagnosis (fragmented red cells are characteristic) and prevented potentially dangerous transfusion. The diagnosis of TTP is urgent, and patients should be started on plasma exchange as soon as possible, and platelet transfusion avoided.

Platelets were transfused inappropriately when not indicated prior to procedures, in excess quantity for the procedures undertaken, and prior to procedures that were subsequently cancelled.

There were 2 cases in which patients were transfused platelets inappropriately in order to achieve a count of >50x10^9/L prior to insertion of a nasogastric tube. This is not in accordance with British Society for Haematology (BSH) guidelines on the use of platelet transfusions (BSH Estcourt et al. 2017).

Case 11b.8: Excessive platelets requested to cover a procedure that was subsequently cancelled

A patient with myelofibrosis and a chronically low platelet count was due to undergo a liver biopsy. The platelet count was stable at around 40x10^9/L. Six units of platelets were requested to cover the procedure by a consultant haematologist. Two units were transfused prior to the procedure,

which was subsequently cancelled, following concerns raised by a junior doctor and interventional radiologist who had not been consulted in advance and considered the procedure too risky. The laboratory staff had also raised concerns regarding this request. There was a comment made in relation to this event, that due to the culture at the hospital, laboratory staff did not feel empowered to act further.

Platelets are a valuable resource that should be used judiciously and in accordance with national guidelines. It is important that hospitals have policies to guide the use of platelets and that all members of staff, including the laboratory team, are empowered to raise concerns in a culture of openness. An adult treatment dose is a single bag of platelets.

Learning point

- Thrombocytopenia has several causes, many of which are not best managed by platelet transfusions. It is important to make a diagnosis as platelet transfusion may be contraindicated. Unexpected thrombocytopenia should always prompt film examination and, if necessary, confirmation on a repeat sample

IT-related avoidable transfusions n=5

Transfused on the wrong result n=5

Two patients were transfused because of an incorrect Hemocue™ result and one following a series of incorrect Hb levels on a blood gas analyser. In another patient a WBIT led to a platelet transfusion but the previous FBC result could not be checked because of computer downtime. The wrong (old) Hb result was used to initiate transfusion rather than the current (higher) Hb because the electronic patient record (EPR) results screen did not default to the current result.

Commentary

All the examples reported here are similar to previous years. It is important that clinical staff understand the rationale and indications for any blood component transfusion and ensure that there is no alternative. A novel approach has been taken in one district general hospital. The transfusion prescription is a comprehensive folded document which includes prescribing codes for red cells, platelets, FFP and cryoprecipitate. This was introduced in May 2017; nursing staff were trained not to proceed without a code, and if none was applicable to contact a haematologist. Audit demonstrated a 16.2% reduction in red cell use (McGrann 2018).

References

BSH Estcourt L J, Birchall J et al. Guidelines for the use of platelet transfusions. *Br J Haematol* 2017;**176(3)**:365-394.

McGrann A. Reducing red cell use by 16% by mandating an indication code derived from NICE guidance and the NBTC's transfusion audit codes on every blood prescription in a large District General Hospital. *Br J Haematol* 2018;**181 Suppl 1**:34.

NICE. Guideline NG24 Blood transfusion 2015
https://www.nice.org.uk/guidance/ng24/chapter/Recommendations#alternatives-to-blood-transfusion-for-patients-having-surgery-2 [accessed 18 March 2018].

Under or Overtransfusion n=24

11c

A similar number of errors of transfusion volume were reported as in 2016 (n=21). There were 2 deaths where these errors were contributory, and several mistakes were made for transfusions in children. These cases are reported in Chapter 22, Paediatric Summary.

Undertransfusion n=5

Death probably related to undertransfusion n=1

Case 11c.1: Undertransfusion in a patient with GI bleeding probably contributes to death

A man in his 50s presented with postural hypotension. It was not initially recognised to be secondary to GI bleeding as initially he was physiologically well-compensated. On decompensation it came apparent that he had had a significant GI bleed. Two units of red cells were transfused but the patient died and was probably under filled.

Prompt recognition of bleeding is essential but this can sometimes be difficult due to the large volume of blood that can be concealed intra abdominally. Regular clinical monitoring is required when there is a suspicion of GI bleeding. Once confirmed, activation of the MHP with use of adjuncts such as tranexamic acid may help stabilise patients while the underlying cause is detected and treated.

Overtransfusion n=19

Death possibly related to overtransfusion n=1

Case 11c.2: Failure to check response to transfusion led to overtransfusion and possibly contributed to a poor outcome

A man in his 70s had a cardiac arrest, while in a CT scanner, following an endovascular aneurysm repair (EVAR). The arrest was thought to be secondary to major haemorrhage and the MHP was initiated. Four units of red cells and two units of FFP were transfused. The pre-transfusion Hb was 154g/L. No repeat FBC was taken before transfusing a further four units of red cells. The post-transfusion Hb was 269g/L. The patient required venesection but subsequently died.

This was a complex case and it was noted in the procedural review that the patient had to be moved several times during the course of resuscitation. This may have contributed to the failure to reassess transfusion requirements with repeat blood tests. Nonetheless, it is crucial to monitor response and the need for ongoing blood components.

There were several other cases reported including Case 11c.4 below, in which overtransfusion occurred as a result of inadequate clinical evaluation prior to giving further blood components.

Major morbidity n=1

Case 11c.3: Inadequate clinical monitoring leads to overtransfusion and contributes to intensive care admission

A woman in her 70s was admitted with a chest infection and Hb 66g/L due to suspected myelodysplastic syndrome (MDS). She also had a history of chronic obstructive pulmonary disease and ischaemic heart disease. A chest X-ray (CXR) on admission suggested a left lower respiratory infection. Four units of red cells were given over a 9-hour period; unit one was given over 60 minutes, units two and three over 90 minutes and unit four over 120 minutes. There was no recorded clinical

review or repeat Hb between the units. The patient deteriorated and required admission to intensive care for ventilator support. Case review by respiratory and ITU consultants with the post-transfusion CXR concluded this was primarily left lobar pneumonia and not TACO.

Failure to adequately monitor clinical response to transfusion is a recurring issue. Particular care should be taken in patients at high risk of overload including patients with ischaemic heart disease. The TACO checklist is a useful prompt (Chapter 18b, Transfusion-Associated Circulatory Overload (TACO)).

Case 11c.4: Inadequate monitoring and overtransfusion for iron deficiency in a patient with low body weight

A woman in her 40s was admitted with severe iron deficiency and Hb 28g/L. She weighed 33.4kg and was haemodynamically stable. Over the course of 3 days she received nine units of blood. A FBC was not repeated until all units had been given at which point the Hb was 171g/L.

Several errors were made in this case which led to unnecessary inpatient stay and exposure to blood components:

- Failure to check response of Hb level following each unit
- Overtransfusion in respect of underlying cause. Given the severity of anaemia in this case, initial transfusion of one to two units was reasonable but the mainstay of treatment should have been iron supplementation
- Low body weight not taken into account when considering volume requirement

Case 11c.5: Miscommunication and failure to challenge an unusual order leads to massive overtransfusion of cryoprecipitate

A man in his 70s was admitted with a stroke requiring thrombolysis. He later deteriorated with suspected (intracranial?) haemorrhage. The on-call haematology registrar advised cryoprecipitate if the fibrinogen level was less than 1.5g/L. Ten units of cryoprecipitate were requested and transfused.

There was either miscommunication or misunderstanding between the on-call haematologist and the medical middle grade doctor. Two units of cryoprecipitate, each made of five donor pools, is the correct dose. The patient was given five times this. There were missed opportunities for this dose to be questioned, by the BMS particularly, but also the nursing staff.

Over and undertransfusion in paediatric patients n=14/24 (58.3%)

Thirteen of 19 cases of overtransfusion and 1/5 cases of undertransfusion occurred in paediatric patients. These are described in Chapter 22, Paediatric Summary.

Learning point

- Junior staff working in paediatrics require training in blood component prescribing to avoid potentially dangerous errors. Components should be prescribed in mL. This is particularly important for trainees who rotate from adult medicine. These errors are reported every year. Paediatric guidelines for transfusion should be readily available in all paediatric areas as recommended in recent guidelines (BSH New et al. 2016)

Errors related to transfusion pumps n=4

There were 4 errors related to improper transfusion pump setup. Incorrect setting of the rate led to overtransfusion in 3 cases, all of which occurred in paediatric patients. A case of undertransfusion in an adult occurred due to pump failure and was only noticed after 4 hours. Vigilance is needed, particularly in respect to checking rates and volumes administered to paediatric patients where inaccuracies can have significant consequences due to small circulating volumes.

Reference

BSH New HV, Berryman J et al. Guidelines on transfusion for fetuses, neonates and older children. *Br J Haematol* 2016;**175(5)**:784-828.

Incidents Related to Prothrombin Complex Concentrate (PCC) n=5

11d

A small number of errors in relation to PCC were reported as shown below. These resulted from poor knowledge, inappropriate 'rules' and careless errors.

Learning point

- Guidelines relating to anticoagulant reversal can be followed but must take into account the precise clinical circumstances (Case 11d.2, prothrombin complex concentrate)

Case 11d.1: PCC algorithms should state maximum dosage

A woman in her 40s, weight 138kg, with a retroperitoneal haematoma was prescribed (by a foundation year 2 doctor) and given a PCC dose in the ED based on her weight (4140 units) which exceeded the maximum recommended dose of 3000 units for that particular PCC. This resulted in revision of the PCC algorithm to add the maximum dose and a notice was added to the refrigerator in transfusion to ensure more than the maximum dose could not be issued.

Case 11d.2: Guidelines are not rules

A woman in her 70s who was very unwell with INR 1.3 required an urgent laparotomy for bowel resection. She was on warfarin for atrial fibrillation and had a previous pulmonary embolism. She had initial surgery some days earlier and had been restarted on warfarin. The consultant anaesthetist refused to take her to theatre without PCC; 500 units were authorised by a consultant haematologist. This was against hospital and anaesthetic policy for the management of INR results.

The anaesthetist reported that the plan was to use epidural anaesthesia, which has a higher risk of vertebral canal haematoma, and that since she had recently restarted warfarin the INR was likely to be rising. The operation could not be delayed. The Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidelines (AAGBI 2013) for neuraxial blockade recommend that an INR of <1.5 should be considered safe in a patient with normal risk but notes also that guidelines need to be interpreted for a given clinical situation, so he felt the decision to use PCC was justified.

Learning point

- Guidelines are not rules and should not be oversimplified. Clinical circumstances may overrule the guidance due to other factors which need to be taken into account, and recorded in the case notes. This is resilience

Case 11d.3: FFP should not be used to reverse warfarin

A woman in her 70s who was on warfarin for atrial fibrillation (INR 3.7) developed a rectus sheath haematoma. FFP (two units) was given for warfarin reversal instead of PCC. These were prescribed by a surgical registrar. The patient had a mild allergic reaction. As a result of this case, the PCC pathway was made more accessible to clinical staff.

Case 11d.4: Read the results carefully

A man in his 80s on warfarin for bilateral pulmonary emboli, was admitted with abdominal pain and distension. He was treated with PCC (3000 units) based on an erroneous blood result reported from a point-of-care test where the doctor misread the result (reporting that the Hb had fallen from 145g/L

to 45, but this was the %; actual Hb was 90-102g/L). The patient had already received vitamin K.

Case 11d.5: Consider the timing carefully

A man in his 60s on warfarin received PCC in advance of a renal transplant, but the interval between admission and transplant was sufficient that the INR was corrected to 1.2 by vitamin K and stopping the warfarin so the PCC was unnecessary.

Reference

AAGBI. Regional Anaesthesia and Patients with Abnormalities of Coagulation. 2013 https://www.aagbi.org/sites/default/files/rapac_2013_web.pdf [accessed 18 March 2018].