

Avoidable Transfusions n=106

10b

Definition:

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

Avoidable use of emergency O D-negative blood where group-specific or crossmatched blood was readily available for the patient.

The total of 106 excludes 3 cases classified under delay which were also associated with avoidable transfusion of O D-negative units. This compares with 101 in 2017.

Avoidable transfusions contributed to circulatory overload in 15 cases. These are counted in Chapter 17b, Transfusion-Associated Circulatory Overload TACO).

MHP factors n=12

These cases are discussed in more detail in the section under delayed transfusions.

Cases involving major haemorrhage factors included 9 with MHP activation, resulting in avoidable use of O D-negative units.

In one case, misreading the gas machine result as 'Hb 50' when this was 'HHb', resulted in MHP activation and the patient was transfused.

Most blood gas machines include CO-oximetry as a bolt-on option. It is a separate unit to the main Clarke electrode blood gas analyser. The CO-oximeter unit tends to use specific wavelengths of light to look at oxygenation state of haemoglobin by specific wavelength absorption. Commonly, it reports total haemoglobin (tHb, A in Figure 10b.1), although this is not especially accurate. It also reports carboxyhaemoglobin and methaemoglobin. The final value reported on some (but not all) machines is reduced haemoglobin, i.e. structurally normal haemoglobin in a deoxygenated state. This is often annotated HHb, the first H relating to hydrogen, hence the 'reduced' state (B in Figure 10b.1) and is not the true Hb result.

Results			Crit. Low	Reference Low	High	Crit. High
Measured (37.0°C)						
pH	7.37		[7.20	7.35	7.45	7.60]
pCO ₂	↑ 6.8	kPa	[2.6	4.3	6.4	9.3]
pO ₂	↓ 9.0	kPa	[6.0	11.0	14.4	--]
Na ⁺	↓ 135	mmol/L	[120	136	145	160]
K ⁺	4.2	mmol/L	[2.8	3.5	5.1	6.5]
Cl ⁻	99	mmol/L	[80	98	107	120]
Ca ⁺⁺	1.19	mmol/L	[0.75	1.15	1.33	1.60]
Hct	↓ 35	%	[18	37	50	60]
Glu	↑ 14.4	mmol/L	[2.5	3.6	5.3	25.0]
Lac	↑ 2.3	mmol/L	[--	0.3	2.0	4.0]
CO-Oximetry						
A tHb	↓ 110	g/L	[70	117	174	200]
O ₂ Hb	92.5	%	[--	90.0	95.0	--]
COHb	1.3	%	[--	0.0	3.0	10.0]
MetHb	0.8	%	[--	0.0	1.5	--]
B HHb	↑ 5.4	%	[--	1.0	5.0	--]
sO ₂	94.5	%	[--	94.0	98.0	--]
Derived						
BE(B)	↑ 3.1	mmol/L	[--	-2.0	3.0	--]
HCO ₃ ⁻ std	27.3	mmol/L	[10.0	21.0	28.0	40.0]
↑↓ Outside Reference Range						

Figure 10b.1:
Blood gas result illustrating the difference between total Hb (A) and HHb (B)

Avoidable use of O D-negative units n=27

There were 27 cases of avoidable O D-negative red cell use, of which 9 (see above) were associated with MHP calls and one other with major haemorrhage without MHP activation. In the 10 cases with major haemorrhage, 5 were less than 50 years of age (3 male and 2 female), but 5 were over 60 years of age (3 male and 2 female).

In those without major haemorrhage, n=17, a total of 12 patients 6/8 women and 6/8 men (together 75.0%), were over 50 years of age (in 1 case age and gender was not provided).

A national audit of the use of O D-negative red cells (May 2018) including data from 193 sites with fate known for 5343 units, found that 321 (6%) O D-negative red cell units were transfused to male and female patients >50 years of age as an emergency. This audit reported that 32% of sites do not have a policy to provide O D-positive red cells in an emergency to unknown male patients and females >50 years old.



Learning point

- Group O D-positive units are suitable in an emergency for females over 50 years, and for males >18 years of age

The stability of supply chain for O D-negative red cells is a challenge for all Blood Services. Measures should be in place to ensure supply is adequate for those who need this group the most:

- O D-negative patients with detectable or historical anti-D
- O D-negative women of childbearing potential
- Patients of childbearing potential and paediatric patients of unknown blood group
- O D-negative males <18 years of age

Regularly transfused O D-negative patients and patients whose blood specifications cannot be met within their own blood group might require O D-negative red cells. Unnecessary use outside these indications can destabilise the supply chain and expose the most vulnerable patients to additional risk.



Recommendation

- Hospitals should regularly review their transfusion policies in relation to use of O D-negative red cells and consider including use of O D-positive red cells for males >18 years of age and female patients of non-childbearing potential when an emergency transfusion is required

Action: Hospital/Health Board Transfusion Committees

In 30 patients (including 3 delays) the use of group O D-negative red cells was avoidable;

- In 10 cases group-specific units were available
- In 9 cases delayed provision of crossmatched units was due to an earlier error (includes the 3 delays)
- In 7 cases crossmatched units were available
- In 1 case two samples were taken from the wrong patient
- In 1 case O D-negative was given to a patient with antibodies who could only be crossmatched at a distant centre. This is also potentially unsafe but the emergency need may override this
- In 1 case bleeding post tonsillectomy, the MHP was activated but the patient was transfused with Hb 143g/L
- In 1 case with folate deficiency the MHP was activated inappropriately, Case 10b.4 below

Learning points

- Use of crossmatched or group specific red cells is preferable to use of O D-negative units. Group O D-negative red cells are not safe for all patients. They may be incompatible and result in haemolysis in patients who have irregular red cell antibodies
- Patients should not die from lack of red cells. In major haemorrhage where the patient has a positive antibody screen or known antibodies for which compatible blood is not readily available aim to give ABO, full Rh and K-matched units and discuss with a haematologist

For further information see SHOT Bite No 8. Massive Haemorrhage - Delays (under current resources on the SHOT website www.shotuk.org).

Three cases of delay where emergency O D-negative units were used:

Case 10b.1: Wrong details provided by ambulance staff

A patient was transferred from another hospital with ruptured abdominal aortic aneurysm. Patient details were wrong on the ambulance transfer form (the hospital-based ID band and addressograph labels were not used) and then these wrong details were used for the hospital's information system. Several samples with different spelling of the first name were sent to transfusion; group O D-negative red cells were used in the interim.

Case 10b.2: Wrong bleep number

Emergency O D-negative red cells were used as the ED could not get through to the laboratory staff because they were using the wrong bleep number.

Case 10b.3: Potentially unsafe use of O D-negative units in a patient with AIHA

A patient with AIHA secondary to non-Hodgkin lymphoma and Hb 25g/L had refused blood on religious grounds but on the 3rd day consented to transfusion. Three blood samples were rejected by the laboratory; when satisfactorily repeated, the patient was found to have irregular red cell antibodies, but the clinical team decided to use uncrossmatched O D-negative units.

These are not necessarily safe (see above), but the severity of the anaemia and delay justified this decision.

Why were the samples rejected? The phlebotomist had decided her way of labelling the tubes was neater and so did not follow correct procedure; in addition, the electronic labelling equipment was not working properly.

There was an additional case of delay in a patient with AIHA (Case 10a.11).

Avoidable red cell transfusions in patients with haematinic deficiency n=8

Case 10b.4: Panic at low Hb result led to MHP activation and inappropriate transfusion of three different components for folate deficiency

A woman in her 30s was admitted as an emergency and found to have Hb 30g/L with mean cell volume (MCV) 118fL. The laboratory staff requested a repeat sample, but this advice was ignored. She had no evidence of bleeding or decompensation, was normotensive and had no symptoms of anaemia to warrant transfusion. The haematology registrar had noted the high MCV and advised that haematinics should be checked and not to transfuse the patient. However, a trainee activated the MHP. The BMS, not aware of the clinical situation, did not challenge this and the woman received an inappropriate transfusion of four units of O D-negative red cells together with two of FFP and one of platelets (count $45 \times 10^9/L$). The folate result (<1.6 microg/L indicating severe deficiency) was available 11 hours after the MHP activation.

The patient had severe anaemia and a low platelet count due to the folate deficiency and did not need platelets. Transfusion of one unit of red cells might have been reasonable, but activation of the MHP and transfusion of the other components despite advice to the contrary shows a startling lack of knowledge and lack of respect for the advice given by a specialist.



Learning points

- When a low haemoglobin (Hb) occurs unexpectedly it is advisable to repeat the sample to ensure it is not due to poor sampling
- The mean cell volume (MCV) provided as part of full blood count results can help categorise anaemia and determine which additional investigations are appropriate

There were 7 additional cases of avoidable transfusion in people with iron deficiency anaemia (IDA). Five were prescribed by registrars or foundation year doctors, and one by a consultant. Four were in the ED and two in gynaecology settings. One was caused by analyser error. There were also two cases of delayed transfusion where the primary diagnosis was iron deficiency. In many of these it might have been reasonable to transfuse a single unit if the patient was symptomatic, but all were transfused excessively (Table 10b.1). A further avoidable transfusion for iron deficiency was associated with a febrile reaction and is reported in Chapter 16, Febrile, Allergic and Hypotensive Reactions (FAHR), Case 16.3.



Learning points

- In patients presenting with very low haemoglobin (Hb) before arranging transfusion first diagnose the cause
- Look at the mean cell volume (MCV); this is very elevated in B12 and folate deficiency (treat with the appropriate vitamin and transfusion can usually be avoided even at very low Hb levels)
- The MCV is reduced in iron deficiency proportionate to the degree of anaemia. Treat iron deficiency with iron therapy
- Before transfusion consider underlying risk factors (age, comorbidity particularly ischaemic heart disease)
- Transfuse the minimum amount; if really necessary, give one unit and review
- Note that transfusion-associated circulatory overload (TACO) can be precipitated with rapid correction of anaemia (Case 17b.1, Chapter 17b, Transfusion-Associated Circulatory Overload (TACO))

Table 10b.1:
Excessive
or delayed
transfusions in
iron deficiency

Patient age	Sex	Hb g/L	Number of units transfused	Comments
50s	M	45	3	Known iron deficiency anaemia lost to follow up
50s	F	85	4	Post-transfusion Hb 166g/L. Consultant prescription pre-hysterectomy
80s	F	39	2	Four units were prescribed
Teen	F	NS	2	Menorrhagia
40s	F	49	3	Menorrhagia
70s	F	46	2	Delayed overnight inappropriately*
40s	F	54	NS	Symptomatic anaemia; Three samples rejected due to labelling errors. 5-hour delay

NS=not specified *discussed under delays

Recommendation

- Cases of inappropriate management of haematinic deficiency are reported every year. Education about the haematological effect of iron, B12 and folate deficiency should be taught at undergraduate level

Action: Undergraduate medical and nursing schools

Cases of avoidable transfusions complicated by TACO n=15

These cases are included in the numbers in Chapter 17b, Transfusion-Associated Circulatory Overload (TACO). The causes were mixed but reports usually noted an inappropriate number of units and/or rate of transfusion.

Age of patient	Hb and background	Number of red cell units	Notes
90s	Transfusion based on wrong Hb 67g/L, actual 114g/L	4	Pneumonia and CV* disease
70s	Hb 64g/L, MCV 108	2	Underlying CV disease, 2 nd unit not needed
60s	Hb 66g/L; transfused overnight, sepsis and relapsed lymphoma	3	TACO on 3 rd unit. Should check Hb after each unit
60s	Known low B12 and folate recorded in 2017, confirmed on repeat, and not treated. Hb after one unit 56g/L	1 plus 6 more issued. TACO after 3 of these	Miscommunication resulted in overtransfusion and cardiac arrest
60s	Hb 58g/L chronic iron deficiency (MCV 68fL) due to angiodysplasia	1	TACO with first unit, on aspirin and steroids, no iron
60s	Post operation with background vascular disease	2	Second unit given in error
60s	Intermittent rectal bleeding, not severe	2, then 2 more units despite symptoms of TACO	TACO on 2 nd unit but still more given. Iron advised
50s	Case 17b.1** Hb 34g/L	3 units transfused very rapidly	Cardiac ischaemia and raised troponin
70s	Hb 96g/L, breathlessness attributed to this mild anaemia but may have been heart failure	2, admitted later in day to another hospital	Cardiac disease with heart failure
90s	Hb 64g/L, macrocytic	2, TACO with 2 nd unit	Cardiac disease
70s	Malignancy, respiratory compromise before transfusion, Hb 76g/L	2, TACO 6 hours after 2 nd	On home oxygen
70s	Relapsed lymphoma, Hb 80g/L	2, TACO after 2 nd	One unit sufficient
80s	Hb 78g/L	2, 2 nd was not necessary	Positive fluid balance >1.3L before transfusion
80s	MDS Hb 84g/L	NS*, readmitted with pulmonary oedema	Aortic valve disease
60s	Pancytopenia, Hb 34g/L, platelets 27, neutrophils 0.85 due to leukaemia. Case 17b.3 **	4 units of red cells, 1 of platelets 3 of FFP	Overtransfused and admitted to ITU

*NS=not specified; CV=cardiovascular; MDS=myelodysplastic syndrome

**Chapter 17b, Transfusion-Associated Circulatory Overload (TACO)

Table 10b.2:
Avoidable transfusions precipitating TACO n=15

Other examples of avoidable red cell transfusion:

Case 10b.5: Near miss – avoidable transfusion for one patient is associated with ABO-incompatible transfusion in another due to failure of bedside identification

An elderly patient was admitted after a fall with two fractures. Her Hb was 82g/L and she was transfused with one unit of red cells. A second unit was collected but not given, as it was decided not necessary. This decision should have been made before the unit was collected. However, after checking the unit with the doctor at the nurses' station, transfusion of this unit was started in error on another patient who was also being transfused. This wrong patient received ABO-incompatible red cells as a result and suffered major morbidity (Case 8.1 in Chapter 8, Incorrect Blood Components Transfused (IBCT)).

As a result of this case transfusion training was put back on the organisation-wide programme, competencies will be logged electronically, and the roll out of electronic tracking will include bedside modules.

Three patients transfused who had religious objections to blood components

Case 10b.6: Patient transfused despite religious objection

A woman in her 70s with religious objection received a red cell transfusion (despite having specified that she did not want transfusion) due to failure of handover when she was transferred to ITU.

Case 10b.7: An elderly man with repeated transfusions against his religion was detected incidentally

An elderly man with renal disease was transfused red cells on six occasions over a 3-year period but with no evidence of consent. His religion was not consistently recorded in the notes nor is there evidence that alternatives to red cells were discussed, nor whether or not he consented to red cell transfusion on the last two occasions. This was picked up incidentally at a morbidity and mortality review following trauma management. In 2014 there was evidence of consent for transfusion for serious bleeding when the Hb was 51g/L. On three other occasions he was transfused with no record of consent. The renal physician commented regarding past refusals of transfusion, there is no evidence that this was followed up.

Case 10b.8: Missed advance directive

A patient with religious objection and an advance directive in place was transfused following GI bleeding at a time when lacking capacity. This was discovered later and was due to communication factors and failures to follow hospital policy.

A further case is described under the prothrombin complex concentrate section.

Avoidable transfusion of platelets n=17

Case 10b.9: An inappropriate platelet transfusion due to confusion over names and failure of correct patient identification

A haematology patient informed his consultant that he had been called in for a platelet transfusion 3 months earlier. Despite repeated questioning at the time by the patient, and a normal platelet count of $230 \times 10^9/L$ a month before, he received this transfusion without a check of his count on the day.

The doctor had made a verbal instruction to the booking clerk. Two patients had the same surname and the wrong one was called in for transfusion. The other one, who needed platelets and who had been informed verbally by the doctor, was admitted as an emergency the day before.

There were several failures of procedure. The review resulted in the following corrective actions:

- The patient scheduler will email back to the referring person following a verbal request to confirm identification and instructions

- The prescriber/authoriser will check the platelet count prior to prescribing and will document the result
- The person administering the component will check the count prior to administration
- The transfusion laboratory staff will save and store telephone logs for up to a year

The other 16 cases of inappropriate platelet transfusions included:

- 3 cases where the platelet count was above the threshold for transfusion
- 3 cases where the low platelet count was caused by clumping in the sample
- 2 had dilute samples from drip arms; clinicians ignored the request for repeat
- 1 wrong blood in tube sample
- 1 patient transfused four adult treatment doses of platelets without appropriate indication
- 1 patient was transfused platelets that were intended for weekend cover
- 1 patient was on aspirin and anticoagulants; platelets not correct treatment
- 1 patient with chronic aplastic anaemia without bleeding
- 1 inappropriate transfusion at another hospital
- 1 misreading of the result, '8.6' read when the result was $86 \times 10^9/L$
- 1 transfusion of platelets in major haemorrhage when major haemorrhage Pack 1 erroneously contained platelets (these are included in Pack 2).

Avoidable transfusion of FFP n=4

Case 10b.10: Inappropriate FFP transfusion based on coagulation results from heparinised syringe

Three units of FFP were transfused for abnormal coagulation results prior to surgery. These results were caused by the blood being taken into a heparinised syringe and were therefore invalid.

The patient had possible ascending cholangitis and an endoscopic retrograde cholangiopancreatogram (ERCP) was planned. The white cell count was raised at $23.8 \times 10^9/L$ (normal range $4-10 \times 10^9/L$), with normal coagulation and platelet count.

The next day the white cell count was still raised, and the platelet count had fallen (335 on admission down to $177 \times 10^9/L$). The coagulation screen was abnormal, and repeat was also abnormal with prothrombin time (PT) 23 seconds (s) (normal range (NR) usually 11 to 13.5s), activated partial thromboplastin time (APTT) 40s (NR usually 30-40s but varies with method and range was not given in this case report), and thrombin time (TT) 18s, (NR 12-14s). Two days later the platelet count had fallen to $54 \times 10^9/L$.

The patient was very difficult to bleed; several attempts had been made by different members of staff. It was decided to take an arterial blood sample (and the laboratory had agreed to this). The doctor knew the arterial blood gas kit contained heparin, but he knew the laboratory staff were aware. Blood was taken and then transferred into the coagulation sample tube and into tubes for a full blood count and electrolytes.

The platelet count was $27 \times 10^9/L$ consistent with continued fall. The coagulation screen results were more abnormal with PT 24s, TT 46s and no APTT result could be given. The laboratory comment was 'results abnormal, repeat'. The consultant haematologist reviewed these and previous results, being aware that the patient was difficult to bleed. He decided not to repeat the bloods and advised 10mg IV vitamin K and one unit of platelets followed by a full blood count 1-hour post transfusion to confirm that the platelets incremented by 30-40. He advised that the patient should receive 1 to 2 litres of FFP and be monitored for overload.

The following morning a full blood count and coagulation screen showed that the platelet count was $20 \times 10^9/L$ and the coagulation was normal. Another request was made for a unit of platelets pre-procedure. The junior doctor who had come back on duty noted the grossly abnormal results from the previous evening. He asked his colleague if there had been any difficulties taking the sample. At this point the junior doctor realised what had happened regarding the results due to the heparin contamination.

Lessons learnt

- Samples for coagulation studies must not be taken in any sample bottles containing heparin
- If staff are struggling to take coagulation screen samples the coagulation department should be contacted directly to discuss the options available to them with one of the BMS staff. The department can provide smaller bottles (1.2mL) compared to the normal 3.2mL fill volume
- If in the future abnormal coagulation screen results of a similar nature are obtained the laboratory should perform a fibrinogen (if there is enough sample and it is not too old to analyse)

It is surprising that the consultant haematologist did not recognise the characteristic abnormalities associated with heparin in the sample – a relatively unchanged PT, prolonged TT and unrecordable APTT. These results were very different to the previous ones and not characteristic of hepatic dysfunction.

Commentary

- Many avoidable transfusions demonstrate a surprising lack of knowledge of basic haematology which should be taught at undergraduate level, particularly the characteristic features in the blood count in iron, B12 and folate deficiency
- Group O D-negative blood is a precious resource and it is clear that hospital policies could permit greater use of O D-positive units for older women and men in an emergency
- Avoidable transfusions contributed to several cases of TACO reinforcing the messages and recommendation for appropriate pre-transfusion assessment