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Perioperative blood transfusion: a plea for guidelines

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Red blood cells are still transfused inappropriately in spite of recent media attention and public awareness about the risks of blood products. A prospective audit was conducted to determine the avoidable blood transfusion rates in the elective perioperative setting utilising the guidelines issued by the American College of Physicians (ACP). Of 82 consecutive adult patients who were admitted for major elective surgery over a 3-month period, 28 were transfused a total of 94 units of homologous SAG-M blood, of which 50 (53%) were inappropriate as recommended by the ACP guidelines. Violations of the guidelines were perioperative transfusion in bleeding patients who were haemodynamically stable (31%) and transfusion in asymptomatic, stable patients solely to attain a haemoglobin level above 10 g% (22%).

There is a need for objective, easily adaptable and widely disseminated consensus guidelines to the indications for red blood cell transfusion.

Although allogenic blood transmission is becoming safer, significant risks still remain. The risk for transmitting hepatitis C is 1/50 000 transfusions, hepatitis B 1/150 000 transfusions and HIV 1/100 000 transfusions *(1)*. There is evidence that perioperative blood transfusion increases the likelihood of infectious complications after surgery *(2,3)*. Transfusion in oncological surgery may increase the risk of recurrence and decrease long-term survival *(2,4,5)*. The incidence of immunological issues such as transfusion-related acute lung injury and transfusion-associated graft-*versus*-host disease is unknown, though both are serious conditions with mortality rates of 5% and 70%, respectively *(6–8)*. Although most patients receive transfusion without any obvious detrimental effects, its safety cannot be guaranteed *(9)*. One unit of SAG-M blood costs the blood bank £53.67 (data from Haematology Department of Leighton Hospital, Crewe, Cheshire) and alloimmunisation makes it more expensive still. In view of these factors, it has been considered prudent practice since the mid-1980s to regard elective allogenic transfusion as a procedure to be avoided if possible. This has led to recent interest in various methods of autologous transfusion *(9)*.

An audit was conducted in the Memorial Hospital, Darlington, to determine whether any avoidable blood transfusion occurred in the perioperative setting and, if so, to ascertain the reasons for the inappropriate transfusion. As in other similar studies the crtieria for assessing the appropriateness of transfusion were difficult to determine *(10)*. There are no guidelines in the UK, but the American College of Physicians (ACP) produced guidelines in 1992 which address the issue of transfusion in the perioperative setting, including transfusion for anaesthetised patients *(11,12)*. An abbreviated version of the ACP guidelines is given in Table I.

Methods

All major elective cases in one adult (above 16 years) surgical ward were studied prospectively over a 3-month period between August and November 1995. On admission, a detailed history was taken and examination carried out by the author, who was independent of the care of the patient, in order to assess the risk of myocardial or cerebral ischaemia from volume depletion as outlined in the ACP guidelines. Patients who received transfusions were studied in detail, their charts and anaesthetic records being scrutinised for heart rate, blood pressure, fluid intake and output and, if recorded, the central venous pressure. These were used as indicators of the intravascular volume status at the time of transfusion. Patients

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Table I. American College of Physicians (ACP) guidelines for transfusion for transient anaemia from acute blood loss *(11)*

1 Intravascular volume of patients should be adequately restored with crystalloids.

2 Asymptomatic normovolaemic patients with stable vital signs need not receive blood transfusion regardless of the haemolgobin levels since normovolaemic anaemia is well tolerated.

3 Patients who are symptomatic* or who develop unstable vital signs despite crystalloid therapy should receive transfusion. (*Syncope, dyspnoea, postural hypotension, tachycardia, angina, and transient ischaemic attacks).

4 Blood should be transfused *unit by unit*. One unit may be sufficient.

5 *Patients under anaesthesia:*
(a) *Stable vital signs.* If not at risk of myocardial or cerebral ischaemia from intravascular volume depletion †, transfusion is not indicated independent of the haemoglobin level.
(b) *Unstable vital signs.* If not at risk †, intravascular volume should be adequately restored with crystalloids. If at risk †, blood should be used unit by unit to stabilise vital signs. Remember one unit may be sufficient.

(† Patient groups at risk of myocardial or cerebral ischaemia are those with coronary artery disease, valvular heart disease (eg haemodynamically significant aortic stenosis), congestive heart failure, history of transient ischaemic attacks or previous thrombotic stroke.)

6 Use autologous blood if available.

who were transfused when unanaesthetised were questioned directly for symptoms of syncope, dyspnoea, angina or transient ischaemic attacks before and after transfusion. The reason for transfusion was obtained from discussion with the doctor who ordered it. The haemoglobin levels before and 48 h after transfusion were recorded. The appropriateness of each unit of transfusion was determined by referral to the ACP guidelines.

Results

Eighty-two consecutive patients undergoing elective general, vascular and urological operations were studied. In all, 28 (34%) received blood transfusions. Details of the transfused and non-transfused patients are shown in Table II. None of the non-transfused patients had any indication for transfusion as per the ACP guidelines.

The 28 transfused patients received a total of 94 units of homologous SAG-M blood. Of these units, 50 (53%) given to 22 patients were considered to be inappropriate as recommended by the ACP guidelines. Of the 28 patients receiving blood transfusion, 11 were considered to be at risk of myocardial or cerebral ischaemia from volume depletion. These 11 patients received 56 units in total, of which 44 were appropriate and 12 inappropriate. The 17 remaining patients, not at risk of cerebral or myocardial ischaemia from volume depletion received 38 units, all inappropriate (Table III).

Table II. Details of patients studied

Details	*No transfusion*	*Transfusion*
Number	54	28
Median age (range) in years	63 (23–81)	64 (48–86)
Male/female	38/16	19/9
At risk of cerebral or myocardial ischaemia from volume depletion	12	11
Mortality	0	0
Operations		
TURP	25	5
Nephrectomy/ nephroureterectomy	7	0
Vascular	8	9
Mastectomy	3	0
Thyroidectomy	3	0
Gastrointestinal	8	14

Table III. Appropriate and inappropriate transfusion groups

	Number	*Total units transfused*	*Appropriate units*	*Inappropriate units*
Patients at risk*	11	56	44	12
Patients not at risk*	17	38	0	38

* At risk of cerebral or myocardial ischaemia from intravascular volume depletion (Table I)

The inappropriate transfusions (the violations of ACP guidelines) fell into two groups:

1 Intraoperative transfusion in bleeding patients who were haemodynamically stable and normovolaemic: 29 units given to 13 patients (31% of all transfusions). These patients are considered further in Table IV.
2 Preoperative or postoperative transfusion in asymptomatic, normovolaemic patients with stable vital signs merely to achieve a haemoglobin level above 10 g%: 21 units transfused to nine patients (22% of all transfusions). Their details are considered in Table V.

Discussion

Over one-half (53%) of the transfusions given were considered unnecessary in the present study according

Table IV. Inappropriate transfusions during operation in patients who were haemodynamically stable

	Operation	*Age*	*Inappropriate units*	*Posttransfusion haemoglobin (g%)*
1	Femoropopliteal bypass	62	2	10.9
2	TURP	72	2	14.2
3	TURP	74	2	12.7
4	TURP	68	2	14.1
5	TURP	69	2	13.9
6	TURP	73	2	14.2
7	Sigmoid colectomy	48	1	13.0
8	Sigmoid colectomy	54	2	14.1
9	Right hemicolectomy	63	2	10.8
10	AP excision of rectum	50	3	11.0
11	AP excision of rectum	66	4	15.6
12	Gastrectomy	63	2	12.7
13	Oesophagogastrectomy	60	3	12.0

Table V. Inappropriate transfusions in asymptomatic normovolaemic patients with stable vital signs to attain a haemoglobin level above 10 g%

	Operation	*Age*	*Pretransfusion haemoglobin (g%)*	*Inappropriate units*	*Timing of transfusion*
1	Left hemicolectomy	50	9.2	3	preop
2	BK amputation	68	9.9	2	postop
3	BK amputation	52	8.1	2	postop
4	AK amputation	70	9.1	2	postop
5	Gastrectomy*	56	8.7	2	preop
6	Revision-Roux-en-Y-gastrojejunostomy*	70	9.4	3	postop
7	Cholecystectomy*	58	8.8	2	postop
8	Resection small bowel tumour*	54	8.6	2	postop
9	Left hemicolectomy*	64	9.8	3	postop

*At risk of cerebral or myocardial ischaemia from intravascular volume depletion
BK = below-knee AK = above-knee

to the ACP, largely because of their comparatively strict 'clinical' guidelines *(11)*. If a transfusion trigger of 10 g% of haemoglobin was taken as a guideline (as is the practice in many units *(9,13,14)*), a further 21 units would have been considered appropriate, reducing the inappropriate transfusion rate from 53% to 31%. Is there a clinical or physiological basis for transfusion at haemoglobin concentration below 10 g%? The primary rationale for red blood cell transfusion is to increase the oxygen-carrying capacity and this depends on the haemoglobin level. Considering that 1 g of haemoglobin at full saturation carries 1.34 ml of oxygen, the total oxygen-carrying capacity in a normal adult with a haemoglobin of 10 g% would be approximately 670 ml/min (1.34×10× cardiac output). A proportion of this oxygen supply cannot be extracted by the tissues since there is a need to maintain the arterial–venous oxygen content difference at about 25%, as was first described by Fick *(15)*. But the normal oxygen consumption is only 250 ml/min and indicates a wide margin of safety built into the oxygen delivery system *(16)*. Additionally, there is more efficient oxygen delivery in anaemia because of the rightward shift of the oxyhaemoglobin curve (increased levels of 2,3,diphosphoglycerate and the Bohr effect). The other major adaptation in normovolaemic anaemia is an increased stroke volume predominantly because of decreased afterload (diminished blood viscosity and vasodilatation) *(12)*. Thus, tissue oxygenation is maintained at haemoglobin levels well below 10 g%, but the lowest 'safe' level of haemoglobin is not yet defined.

In this study, 31% (29 units) of the transfusions given were to patients who were bleeding intraoperatively but who were haemodynamically stable and normovolaemic at all times. The anaesthetists' reason for transfusion was that surgical blood loss was excessive and would have led on to haemodynamic instability if blood was not transfused. These were anticipatory transfusions. ACP guidelines do not allow for prophylactic blood transfusions, even in the presence of risk factors such as myocardial or cerebrovascular ischaemia. The difficulty of estimating blood loss during surgery is well recognised and the decision to transfuse during surgery is often influenced by the local policy and personal clinical preferences *(17)*. A previous American study found widespread deficiencies in doctors' knowledge of transfusion risks and indications *(18)*. Widely disseminated

consensus guidelines might improve transfusion decision making under these circumstances.

Many doctors believe that single unit transfusions are unjustified *(19,20)* but there is no sound scientific basis for this hypothesis as a single unit of blood may be sufficient *(11)*. Only one patient in this study received a single unit transfusion: two units were to be transfused but he suffered an allergic reaction with the first unit.

The ACP guidelines provide a useful framework for transfusion practices, but they lack objectivity owing to the absence of a transfusion trigger or haemoglobin threshold. The original paper on which the ACP guidelines were based suggested a minimum haemoglobin concentration of at least 7 g% for patient safety *(12)*. Perhaps this value of haemoglobin may make ACP guidelines more easily adaptable to the practice of transfusion.

Despite numerous efforts to improve the use of this scarce and costly resource, evidence documenting the inappropriate transfusion of blood continues to grow. The reasons for inappropriate transfusions in the perioperative environments are:

1 Adherence to a 'transfusion trigger' dependent on a haemoglobin level that is too high.
2 Insufficient significance being paid to the symptoms rather than the haemoglobin level.
3 Belief that single unit transfusions are unjustified.
4 Perhaps most importantly, lack of widely disseminated consensus guidelines in UK hospitals.

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