Uncross-matched blood is unnecessary

Michael JG Thomas

The proposition 'uncross-matched RBCs save lives' cannot be justified by just showing a few lives are saved in one of the world's major trauma centres. It must be shown that, when used in an ordinary hospital setting, more lives are saved than lost. What are the risks and what are the benefits of using uncross-matched blood and, on balance, which is the greater? To answer this we need to ask three questions: Is uncross-matched blood necessary, safe and the best use of resources?

IS UNCROSS-MATCHED BLOOD NECESSARY?

The answer is negative for a number of reasons, the first of which is evolution. Modern humans are all polycythaemic. Phylogenetically, modern human bone marrow behaves as though modern

Dr Michael JG Thomas is Clinical Director, The Blood Care Foundation, Fleet, Hants GU51 1HG

humans were still living in the middle ages when, for much of the year, they were chronically anaemic. Red cell production is geared to those times when humans were riddled with hookworms, had an inadequate diet for half the year, and suffered frequent horrific battle injuries. Over 30 years ago Messmer et al (1972) showed that the heart worked most efficiently at a haematocrit of 25–30%. Cardiac surgeons quickly learnt this fact and currently safely operate at a haemoglobin level of 70–80 g/litre (Messmer, 1988). This means that most healthy people with a normal haemoglobin level of around 140–150 g/litre can lose half their blood volume and suffer no untoward consequences, as long as they are given adequate fluid replacement to restore their intravascular volume. In acute trauma people die, not from anaemia, but rather from shock caused by hypovolaemia and the best treatment is resuscitation fluids not blood.

This leads to the second reason which is illustrated by the work of Mattox's group (Bickell et al, 1994) showing that, in cases of trauma, the best outcome is achieved when aggressive fluid resuscitation is delayed until operative intervention. In other words get the patient into the operating theatre before commencing transfusion (Jacobs, 1994). Using modern rapid grouping and equally rapid cross-matching techniques, properly cross-matched blood can be ready for transfusion by the time the patient has arrived in the operating theatre.

Third, intraoperative cell salvage can immediately provide blood for transfusion and can be used even in an infected or contaminated operative field (Thomas, 1999). Every trauma unit should have staff available at all times who are capable of operating cell salvage machines. Machines are now designed not only for use in the operating theatre, but the new portable machines allow the technique to be practised in the accident and emergency department or even in a field hospital.

Fourth, although surgical techniques are improving, providing better control of haemorrhage and delaying the requirement for transfusion, a number of new agents may have life-saving properties when bonewax, Gelfoam (Pharmacia & Upjohn Inc, Bridgewater, NJ, USA), thrombin, packing and electrocautery have failed. These new agents include activated factor VII (NovoSeven, Novo Nordisk A/S, Bagsværd, Denmark) (Key et al, 1998) and the mineral haemostatic agents such as QuickClot (Z-Medica, Newington, CT, USA) (Wright et al, 2004). The use of such agents will buy sufficient time for a full cross-match to be performed.

Last, oxygen-carrying fluids have always been considered the holy grail for trauma resuscitation. They will be the ideal resuscitation bridge, capable of delivering oxygen to the tissues until properly cross-matched blood is available, and when the only available blood is old they give better oxygen delivery than stored blood. In many cases they may enable the patient to avoid allogeneic transfusion completely. There have been many false dawns but phase 3 trials have shown that these are now ready for clinical use (Gould et al, 2002; Levy et al, 2002). Both human- and bovine-derived products are being developed, and the bovine version is licensed for human use in South Africa.

IS UNCROSS-MATCHED BLOOD SAFE?

The dangers associated with the use of uncross-matched blood fall into two categories. First, there are the problems solely associated with uncross-matched blood and, second, those associated with all allogeneic transfusions.

While donated blood is screened for the common atypical antibodies, the patient's serum may contain rarer antibodies which react with the antigens on the transfused cells, leading to a reaction. In very rare cases, such as Bombay blood groups, such reactions can be fatal.

Investigations conducted by Silliman et al (2004) have shown that the risk of developing multiple organ failure (MOF) following trauma is directly proportional to the amount of blood transfused. In addition, the earlier a transfusion is given, the greater the risk of MOF. The availability of uncross-matched blood will encourage a knee-jerk reaction to transfuse early, whereas using the alternative methods already described, the transfusion could be delayed or even completely avoided.

The risk of MOF also increases with the age of the transfused blood. As uncross-matched blood may well be the oldest blood available, the increased risk of MOF must be taken into account. In addition, older blood is associated with increased length of hospital stay, increased risk of infection and, most importantly, decreased oxygen delivery to the tissues. As blood ages, so 2,3-diphosphoglycerate (2-3DPG) acid is lost and the oxygen dissociation curve is shifted to the left. It takes up to 12 hours post-transfusion for this to be corrected, during which time the load on the heart is increased as a result of the increase in viscosity, but the oxygen delivery is, if anything, worse. The increase in the haemoglobin and haematocrit levels may be a comfort to the surgeon, but they do the patient little good and perhaps harm.

The availability of uncross-matched blood will encourage a knee-jerk reaction to use allogeneic blood when the other measures already mentioned, given a short delay, may be sufficient. In these cases all the dangers of allogeneic blood must be taken into account. These include disease transmission, alloimmunization, immunosuppression and transfusion-related acute lung injury, all of which would not occur if allogeneic transfusion is avoided.

IS UNCROSS-MATCHED BLOOD THE BEST USE OF RESOURCES?

When blood is to be transfused uncross-matched, the least dangerous blood to use is O negative. O negative is always scarce because it is the so-called 'universal donor' group but, even among white Caucasians, it is only found in 7% of the population. In other parts of the world the incidence is much lower, especially in parts of Asia where the incidence is less than 0.1%. It is therefore extremely wasteful to use blood of this group in a haphazard way when alternative procedures can give as good, if not a better, clinical response. Waste of this resource could well cause the public to cease donating blood (Hess and Thomas, 2003). In addition, this scare resource may not be available when required; therefore to rely on it may well give the surgeon a false sense of security.

Blood of whatever group has a short shelf-life and has to be transported and stored under very strict conditions. This is another good reason for not using it haphazardly or unnecessarily.

CONCLUSIONS

The use of uncross-matched blood is unnecessary, wasteful, dangerous and it may not be available when it is needed. In other words, emergency transfusion of uncross-matched blood may treat the surgeon but it certainly will not treat the patient. HM

Conflict of interest: none

Bickell WH, Wall MJ Jnr, Pepe PE et al (1994) Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. *N Engl J Med* **331:** 1105–9

Gould SA, Moore EE, Hoyt DB et al (2002) The life-saving capacity of human polymerized haemoglobin when red cells might be unavailable. *J Am Coll Surg* **195**(4): 445–55

Hess J, Thomas MJG (2003) Blood use in war and disaster: lessons from the past century. *Transfusion* **43**(11): 1622–33

Jacobs KM (1994) Timing of fluid resuscitation in trauma. *N Engl J Med* **331:** 1153–4

Key NS, Aledort LM, Beardsley D et al (1998) Home treatment of mild to moderate bleeding episodes using recombinant factor VIIa (NovoSeven) in haemophiliacs with inhibitors. *Thromb Haemost* **80**(6): 912–18

Levy JH, Goodnough LT, Greilich PE et al (2002) Polymerized bovine hemoglobin solution as a replacement for allogeneic red blood cell transfusion after cardiac surgery: results of a randomized, double-blind trial. *J Thorac Cardiovasc Surg* **124**(1): 35–42

Messmer K, Sunder-Plassman L, Klovekorn W, Holper K (1972) Circulatory significance of hemodilution: rheological changes and limitations. *Adv Microcirculation* **4:** 1–77

Messmer K (1988) Hemodilution – possibilities and safety aspects. *Acta Anaesthesiol Scand* **32**(Suppl 89): 49–53

Silliman CC, Moore EE, Johnson JL et al (2004) Transfusion of the injured patient: proceed with caution. *Shock* **21**(4): 291–9

Thomas MJG (1999) Infected and malignant fields are an absolute contraindication to intraoperative cell salvage: fact or fiction? *Transfus Med* **9**(3): 269–78

Wright FL, Hong MS, Hua T et al (2004) Intracorporeal use of the hemostatic agent QuickClot in a coagulopathic patient with combined thoracoabdominal penetrating trauma. *J Trauma* **56**(1): 205–8

KEY POINTS

- Blood transfusion is best delayed until the patient is in the operating theatre thereby allowing adequate time for cross-matched blood to be provided.
- The provision of intraoperative cell salvage frequently avoids the need for any allogeneic blood to be transfused.
- The use of new agents such as activated factor VII and mineral haemostatic agents delays the need for transfusion until cross-matched blood to be provided.
- Early transfusion, especially of older blood, as is likely to be the case when uncross-matched blood is used, increases the risk of multiple organ failure.
- The transfusion of uncross-matched group O rhesus (D) negative blood is a waste of a scarce resource.

POINTS OF AGREEMENT

- There is a place for the use of uncross-matched blood in highly specialized centres of excellence.
- Problems with alloantibodies are rare.

POINTS OF DISAGREEMENT

- The use of uncross-matched blood in the majority of hospitals is not necessary as better alternatives are available.
- The use of uncross-matched blood is frequently a waste of scarce resources.
- The availability of uncross-matched blood leads to patients being exposed unnecessarily to allogeneic transfusion.