TESTING BEFORE TRANSFUSION, AND
BLOOD ORDERING POLICIES

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Identification of red cell antibodies can be an elaborate procedure.

If tests are done to ensure that donor and recipient belong to the same blood group (ABO) then—even if no other tests are done—the donor’s red cells will be compatible with the recipient’s plasma in about 97% of cases. In practice the presence of the Rh D antigen on the red cells of donors and recipients is also determined, mainly so that Rh positive red cells will not be given to an Rh negative recipient. This procedure not only prevents accidental induction of Rh immunisation but also ensures that Rh positive red cells are not transfused to those patients (about 1% of recipients) who have already developed Rh antibodies. Thus when donor and recipient belong to the same ABO and Rh groups, the transfusion will be compatible in about 98% of cases.

To ensure compatibility in the remaining 2% serological tests must be carried out to identify other antibodies that may be present in the recipient’s blood. Because compatible blood can readily be found for most recipients there is a tendency for doctors to regard blood as a standard pharmaceutical product that can be made available at short notice. It must not be forgotten that safety can be maintained only by carrying out elaborate tests, and these take time.

Blood grouping and antibody screening

	Blood group			
	O	A	B	AB
Antigens on red (and other) cells	None	A	B	A+B
Antibody in serum	anti-AB	anti-B	anti-A	None
Approximate percentage in United Kingdom	47	42	8	3

As soon as it has been decided that a patient needs (or is reasonably likely to need) a transfusion, one sample of clotted blood and one sample that has been anticoagulated in EDTA should be sent, together with a properly completed request form, to the hospital transfusion laboratory. In patients who may have developed antibodies it is important that the samples should be taken only a short time before transfusion. In practice, if patients have received transfusions or been pregnant within three months the samples should be taken within 48 hours, and if patients have received transfusions less than 10 days previously samples should be taken within 24 hours of the planned transfusion. The request form should contain the name of the clinician responsible for the patient as well as clear and detailed identification of the patient (full name, date of birth, hospital index number, and address). Details of the diagnosis and of potentially sensitising episodes—for example, pregnancy, transfusion, or transplantation—are essential. The number of units of blood required (if any), the degree of urgency, and the expected date of transfusion should also be stated. Incomplete transfusion request forms should not be accepted by hospital transfusion departments.

The two tubes containing the patient's blood must be clearly labelled.

In ABO blood grouping IgM antibodies (for example, anti-A) will directly agglutinate red cells carrying the appropriate antigen.

If the patient's serum has an atypical antibody there will be time to identify it if antibody screening is carried out well in advance of transfusion.

Most deaths associated with blood transfusion are still the result of mistakes in identification, and some of them occur at the stage of taking blood from a potential recipient. Steps that should be taken to avoid such mistakes are:

- (1) The tubes containing blood samples should be clearly labelled with the patient's full name, date of birth, and hospital index number.
- (2) The person taking the blood sample must ensure that the patient is properly identified, either by speaking to the patient or—if the patient is unconscious—by examining the wrist band. Ideally, the tubes should be labelled after they have been filled with blood.
- (3) There should be no discrepancy between the information on the request form and that on the tubes.
- (4) For those patients with previous blood bank records the current information must be identical with that on the old records.

• Blood grouping

The patient's red cells are grouped for ABO and Rh and the serum is tested to confirm the patient's ABO group. Grouping for ABO is essential because of the invariable presence of naturally occurring haemolytic antibodies in the plasma of subjects who lack the corresponding antigen so that—for example—group A red cells are always incompatible with those of a group B subject.

On the other hand, the reason for testing the recipient's red cells for the presence of Rh antibodies is that the D antigen is highly immunogenic; roughly 90% of Rh negative subjects transfused with one or more units of Rh positive blood will make anti-D. Immune Rh antibody destroys Rh positive cells and can cause haemolytic transfusion reactions, as well as haemolytic disease of the newborn that may be fatal. Thus it is of particular importance that women of childbearing age should have their blood grouped for Rh before transfusion. Rh negative women should be transfused only with Rh negative blood, but if there is a shortage of such blood unimmunised Rh negative men may safely be given Rh positive blood.

• Antibody screening

Antibody screening against two or three selected screening cells should be carried out on all serum samples to detect any clinically important red cell antibody—that is, one that reacts at 37°C and is then almost always capable of destroying transfused red cells carrying the relevant antigen. When an atypical antibody (one specific against antigens other than A or B) is detected the specificity of the antibody or antibodies must be defined by testing the patient's serum against a collection of fully typed red cells ("identification panel").

For the following reasons grouping and screening should be carried out well in advance of transfusion:

- (1) If the patient has a rare blood group such as B Rh negative there will be plenty of time to order group B Rh negative units from the transfusion centre.
- (2) If an atypical antibody is found there will be plenty of time to identify it and to have its specificity confirmed by a reference laboratory. There will also be time to order antigen negative blood from the transfusion centre. In the case of antibodies to common antigens it may take days to find the required number of units of compatible blood.

Crossmatching

In the antiglobulin test (Coombs' test) red cells coated in vivo (direct antiglobulin test) or in vitro (indirect antiglobulin test) with IgG antibodies (sensitised cells) are washed four times and then incubated with an antihuman globulin reagent. A positive reaction is seen as agglutination of the IgG coated cells by antihuman globulin reagent.

Crossmatching means testing the red cells from donor units against the patient's serum. Whenever possible the donor units should be of the same ABO and Rh group as the patient. It is not necessary to retype the donor units for ABO and Rh as this will have been done (together with a simple antibody screening test) at the regional transfusion centre. It is wasteful to select group O blood for patients who are not group O (in the United Kingdom there is often a surplus of group A blood and a shortage of group O units). On the other hand, group AB patients can be transfused with group A or group B blood if most of the plasma is removed from the units. If grouping and screening have been carried out the main purpose of crossmatching is to confirm ABO compatibility between the donor units and the recipient.

A secondary reason for crossmatching is to detect any reaction between an antibody present in the recipient's blood and rare antigens that may be present on donor red cells but not on screening cells. A simple one tube crossmatch is satisfactory if the proportion of patient's serum to donor's red cell suspension is large and if the test is adequately controlled. After being incubated briefly at room temperature the mixture should be centrifuged and examined for agglutination; if the cells are not agglutinated they should be washed thoroughly, and antiglobulin serum added. After being centrifuged again they should be examined once more for agglutination (indirect antiglobulin test).

Some workers have advocated abolishing crossmatching provided that grouping and adequate screening are done. In the United Kingdom, however, the consensus is that crossmatching is an additional safety measure.

The critical information to be obtained from the label on a pack of blood is: (a) nature of the blood component (for example, whole blood), (b) donation number, (c) ABO and Rh groups, and (d) expiry date.

The minor crossmatch (the testing of the donor's serum against the patient's red cells) is no longer carried out. Only exceptionally potent incompatible antibodies in the donor will destroy the recipient's red cells, and such antibodies will have been detected in the routine screening at the regional transfusion centre and the unit not issued. For those rare emergencies in which group O blood has to be used for group A, B, or AB subjects, units of blood with no plasma or low concentrations of A and B antibodies should be obtained; these are available from most regional transfusion centres.

The final step in a safe blood transfusion is to check, at the bedside or in the operating theatre, that the information on the transfusion request form, the compatibility label, the labels on the unit of blood, the patient's notes, and the patient's identification wrist band all agree. If there is any doubt or discrepancy, transfusion should be withheld until the discrepancy is accounted for. The donation number, blood groups, and expiry date of any unit of blood that is transfused should be entered in the patient's notes as soon as the transfusion is started. This is the only means of ensuring that the ultimate destination of each unit of blood is known. In case of an adverse reaction the regional transfusion centre will have no difficulty in tracing the donor if the donation number is known.

Blood ordering policies

A number of operations do not require blood to be crossmatched.

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More than 70% of blood that is crossmatched is for patients who are about to undergo elective operations. A large proportion of these patients, however, will not be transfused, although compatible units of blood have been reserved and kept unused during the period of the operation. Blood donations may be crossmatched in turn for three or four different patients who have only a small chance of needing a blood transfusion. Some surgeons and anaesthetists always order blood for their patients, even when the operation is one during which transfusion is rarely required. It is for this reason that it is advisable that every hospital (ideally with the help of a hospital transfusion committee) should analyse its usage of blood and establish a crossmatched to transfused ratio for each common elective operation. If the crossmatched to transfused ratio is more than 2:1, it is considered that an excessive number of units is being crossmatched.

After the crossmatched to transfused ratios have been compiled for each hospital all those concerned (surgeons, anaesthetists, physicians, and haematologists) should agree a plan for ordering blood. There should be a list of the common operations for which blood should be crossmatched, with the maximum number of units to be crossmatched for each operation, and a list of those operations for which grouping and screening are enough. The use of such a plan minimises unnecessary crossmatching and reduces the amount of blood that becomes outdated. In addition, it makes it possible to concentrate on providing blood for patients who really need to have transfusions.

Although policies should be laid down for individual hospitals, the requirements of blood for each operation are similar among hospitals. For example, most surgeons do not require blood to be crossmatched for a cholecystectomy, hernia repair, laparoscopy, caesarean section, or colostomy. On the other hand, in most hospitals three or four units are ordered before a hip replacement or radical hysterectomy, two or three for a radical mastectomy, four for insertion of a coronary artery bypass graft, six for an aortofemoral bypass graft, and three for a transvesical prostatectomy.

It should be understood that these policies for ordering blood are not rigid, and it should be easy to overrule them when it is probable that a patient will need more blood than is stipulated—for example, if the operation is likely to be more difficult than usual or if the patient has a coagulation defect. In such cases additional units of blood should be crossmatched as requested by the clinician.

For operations for which less than 10% of patients require blood, a "group and screen" policy is appropriate. If no clinically important antibodies are detected, no blood is crossmatched or reserved and the patient's serum is kept until the seventh day after operation in case transfusion should become necessary. For those patients who are found to have an atypical antibody, "antigen negative" blood should be obtained, crossmatched, and reserved, even when the chance that transfusion will be needed is less than 10%. In addition, the surgeon and anaesthetist should be warned that the patient has an antibody. In those rare cases in which it is particularly difficult to find antigen negative blood the surgeon should be warned as soon as this is known as it may be necessary to postpone the operation.