CHAPTER 1

The Blood Donor: Demographics, Donor Selection and Tests on Donor Blood

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OVERVIEW

- A safe and sufficient blood supply depends upon the recruitment and retention of volunteers who have a low risk of infection with blood-borne viruses and have the committment to make regular blood donations.
- Most blood services world-wide are faced with a challenge in maintaining adequate numbers of safe donors.
- Donor selection is designed to select donors who present a low risk of blood-borne infections and to detect any condition which might make donation hazardous to the volunteer.
- Modern donation screening tests assure a high degree of safety for blood transfusion recipients, but cannot detect all infected donors.
- Increasingly stringent donor selection and donation testing lead to a loss of donors and donations.

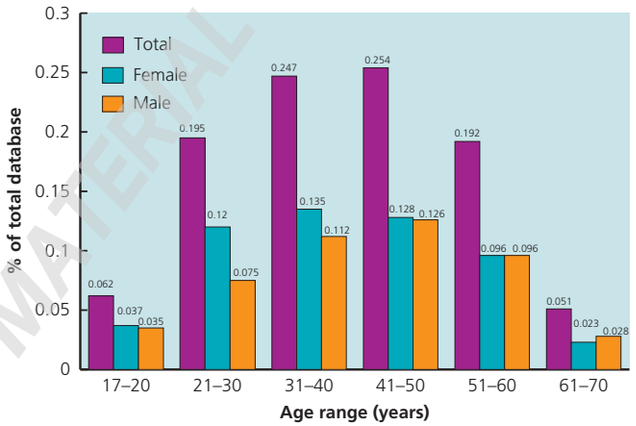

Figure 1.1 Age profile of English donors, January 2005.

Demographics

In the UK all cellular and fresh frozen blood components are sourced from donations made by voluntary unpaid blood donors. A sufficient supply of components for transfusion to patients is therefore reliant upon these altruistic donors continuing to donate. Between 4% and 6% of the eligible adult population donate blood and, in 2005, 1.2 million English donors gave 2.1 million donations. The age range for regular whole blood donation is from 17 to 70 years. New donors are accepted up to their 66th birthday (Figure 1.1).

Donors come from all walks of life but are more commonly from social groups with stable, established lifestyles. Family tradition, peer pressure and personal or professional experience of transfusion are strong motivators.

In recent years it has become more difficult to maintain donor attendance at adequate levels to meet hospital demand. Donor numbers are falling despite heavy investment in recruitment and marketing activity. There are many reasons for this, but the pace of modern living and loss of community spirit are major factors. Others include lack of time, inadequate opportunities to donate, inconvenient venues and/or opening times, fear of needles and simple apathy. Lack of general awareness of the constant need for blood to support routine medical and surgical treatments is another factor. Volunteers flock to donate at times of 'emergency' but tend not to continue once the perceived need is over.

Donor selection

The possibility that donations might present a risk from transfusion transmissible infections or other conditions is minimized through two essential, complementary steps:

1 Robust donor selection procedures to prevent unsuitable donations from being collected.
2 Routine testing of all donations for markers of infection.

Decisions about donor acceptability and screening tests must take into account the characteristics of the donor population and the prevalence of infections transmissible by blood, the susceptibility of the recipient population, and any emerging risks. Two recent examples of the latter are variant Creutzfeldt–Jakob disease (vCJD) and West Nile virus.

Donor selection has two purposes: to protect the donor from harm and the recipient from any ill effects of transfusion. Potential donors should be provided with sufficient information to allow

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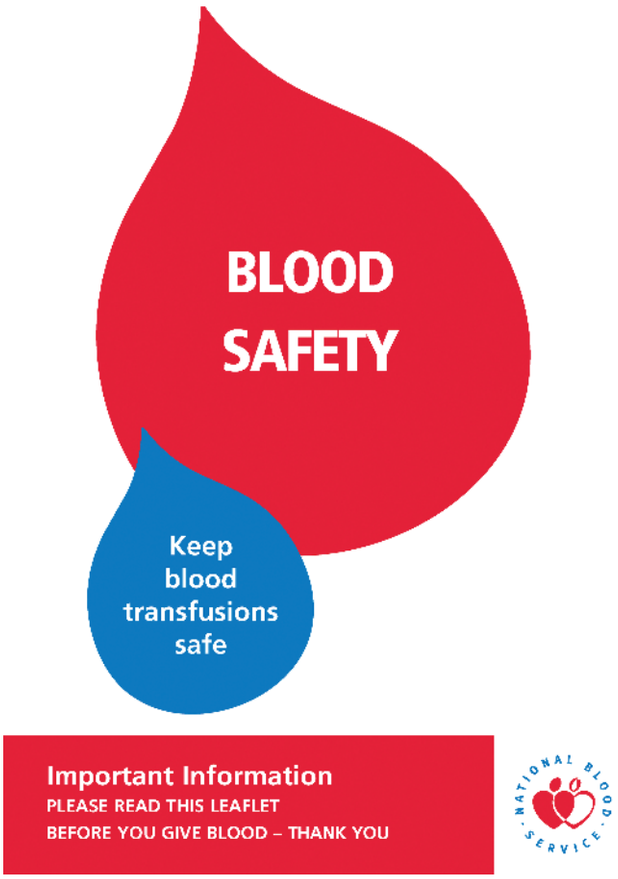


Figure 1.2 National Blood Service blood safety leaflet. (Reproduced by kind permission of the National Blood Service.)

them to exclude themselves; they are required to read essential material before each donation (Figure 1.2).

It is not practical to carry out a full medical examination on every volunteer. Therefore reliance is placed on simple visual assessment and answers to questions about general health, medical history and medication. These are administered using a questionnaire (Figure 1.3) and face-to-face structured interview with a trained member of staff. Confidentiality throughout this process is key to encouraging donors to provide truthful answers. All donors must give informed consent to donation and are required to sign to confirm this before every donation (Box 1.1).

Donor selection criteria

These have been developed and agreed throughout the UK for over 15 years. In November 2005, many selection criteria (particularly with respect to recipient safety) became legal requirements when the EU Blood Directive (2004/33/EC) was incorporated into UK statute (The Blood Safety and Quality Regulations 2005).

Donor safety

Donors must be in good health, within the permitted age range, and meet the minimum requirements for weight, donation volume, haemoglobin and donation frequency (Box 1.2).

The weight and donation volume limits protect the donor from giving more than 13% of their circulating blood volume, to minimize the risk of vasovagal reactions. The minimum haemoglobin levels ensure that: (i) the recipient receives an adequate amount of haemoglobin (minimum 40 g per unit transfused); and (ii) the donor is not rendered anaemic. Before each donation the haemoglobin level is assessed, usually by a simple, semiquantitative, gravimetric method using a drop of capillary blood introduced into a solution of copper sulphate of known specific gravity. This may be supplemented or replaced by the use of portable haemoglobinometers.

Where the potential donor's medical history or medication indicate that the donor is not in good health or that their own health may be adversely affected as a result of donating, they are deferred either permanently (e.g. in cardiovascular disease) or temporarily (e.g. in pregnancy, anaemia or unexplained symptoms awaiting diagnosis).

Medications are rarely a cause *per se* to prevent donation but may indicate underlying pathology that requires the donor to be deferred.

Adverse effects of donation

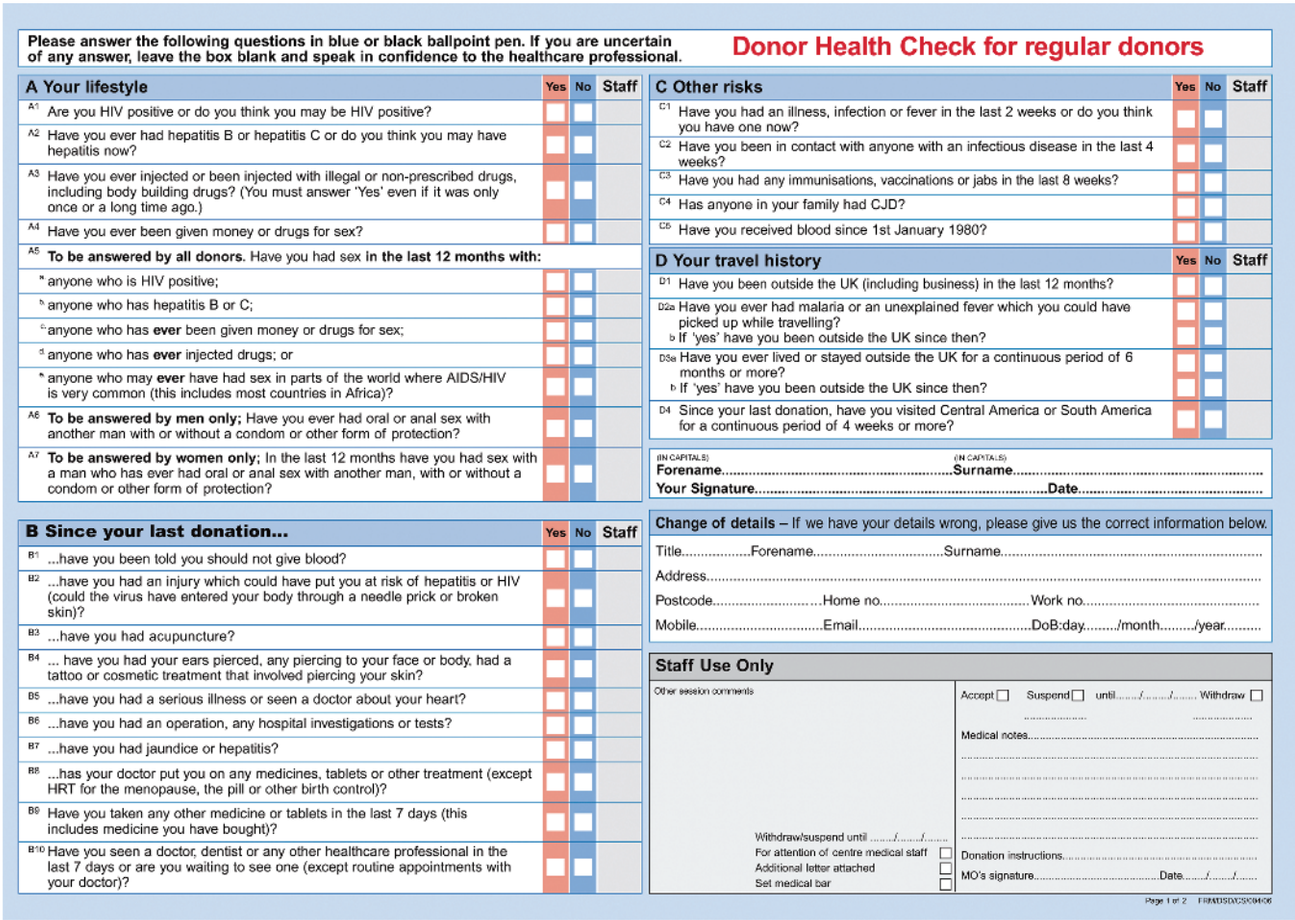
Most donors suffer no ill effects. The most commonly reported problem is bruising and/or a painful arm. The overwhelming majority of these donors require only reassurance and simple first aid, unless complicated by infection or nerve injury. Approximately one in 75 donors feels faint during or shortly after donation and 15% of these suffer syncope (rarely serious unless associated with physical injury or slow recovery). These vasovagal symptoms are more common in younger, first time and female donors. Some donors report fatigue in the days following donation. Iron depletion may also occur and blood donation should be considered in the differential diagnosis of unexplained iron deficiency in regular donors.

Recipient safety

The most important consideration in the selection of donors is to avoid the transmission of infectious agents. The voluntary, unpaid status of UK donors contributes to patient safety as there is no financial incentive to conceal relevant details of medical or personal history. In addition, the fact that most UK blood donors are regular donors is an added safety factor.

Donors whose activities are known to be associated with an increased risk of acquiring infections are deferred temporarily for a period that exceeds the incubation period of the infection or, if there is a screening test which is routinely performed, that exceeds the window period for detection by routine screening tests. Deferral is permanent if the activities are ongoing or the infection is chronic, i.e. the volunteer is a carrier of a blood-borne agent. It is very important to exclude individuals whose behaviours are associated with a high risk of acquiring human immunodeficiency virus (HIV), hepatitis B or hepatitis C, and all donors are asked about these sensitive, personal issues each time they donate (Figure 1.4).

In addition, selection criteria take account of other known infectious risks as well as the small (theoretical) risk that may be posed by diseases of unknown aetiology (Box 1.3).



Please answer the following questions in blue or black ballpoint pen. If you are uncertain of any answer, leave the box blank and speak in confidence to the healthcare professional.

Donor Health Check for regular donors

A Your lifestyle	Yes	No	Staff
A1 Are you HIV positive or do you think you may be HIV positive?			
A2 Have you ever had hepatitis B or hepatitis C or do you think you may have hepatitis now?			
A3 Have you ever injected or been injected with illegal or non-prescribed drugs, including body building drugs? (You must answer 'Yes' even if it was only once or a long time ago.)			
A4 Have you ever been given money or drugs for sex?			
A5 **To be answered by all donors.** Have you had sex **in the last 12 months with:**			
a anyone who is HIV positive;			
b anyone who has hepatitis B or C;			
c anyone who has **ever** been given money or drugs for sex;			
d anyone who has **ever** injected drugs; or			
e anyone who may **ever** have had sex in parts of the world where AIDS/HIV is very common (this includes most countries in Africa)?			
A6 **To be answered by men only;** Have you ever had oral or anal sex with another man with or without a condom or other form of protection?			
A7 **To be answered by women only;** In the last 12 months have you had sex with a man who has ever had oral or anal sex with another man, with or without a condom or other form of protection?			

B Since your last donation...	Yes	No	Staff
B1 ...have you been told you should not give blood?			
B2 ...have you had an injury which could have put you at risk of hepatitis or HIV (could the virus have entered your body through a needle prick or broken skin)?			
B3 ...have you had acupuncture?			
B4 ... have you had your ears pierced, any piercing to your face or body, had a tattoo or cosmetic treatment that involved piercing your skin?			
B5 ...have you had a serious illness or seen a doctor about your heart?			
B6 ...have you had an operation, any hospital investigations or tests?			
B7 ...have you had jaundice or hepatitis?			
B8 ...has your doctor put you on any medicines, tablets or other treatment (except HRT for the menopause, the pill or other birth control)?			
B9 Have you taken any other medicine or tablets in the last 7 days (this includes medicine you have bought)?			
B10 Have you seen a doctor, dentist or any other healthcare professional in the last 7 days or are you waiting to see one (except routine appointments with your doctor)?			

C Other risks	Yes	No	Staff
C1 Have you had an illness, infection or fever in the last 2 weeks or do you think you have one now?			
C2 Have you been in contact with anyone with an infectious disease in the last 4 weeks?			
C3 Have you had any immunisations, vaccinations or jabs in the last 8 weeks?			
C4 Has anyone in your family had CJD?			
C5 Have you received blood since 1st January 1980?			

D Your travel history	Yes	No	Staff
D1 Have you been outside the UK (including business) in the last 12 months?			
D2a Have you ever had malaria or an unexplained fever which you could have picked up while travelling?			
b If 'yes' have you been outside the UK since then?			
D3a Have you ever lived or stayed outside the UK for a continuous period of 6 months or more?			
b If 'yes' have you been outside the UK since then?			
D4 Since your last donation, have you visited Central America or South America for a continuous period of 4 weeks or more?			

(IN CAPITALS) Forename..... (IN CAPITALS) Surname.....

Your Signature..... Date.....

Change of details – If we have your details wrong, please give us the correct information below.

Title.....Forename.....Surname.....

Address.....

Postcode.....Home no.....Work no.....

Mobile.....Email.....DoB:day...../month...../year.....

Staff Use Only

Other session comments

Accept ☐ Suspend ☐ until ...../...../..... Withdraw ☐

Medical notes.....

Withdraw/suspend until ...../...../.....

For attention of centre medical staff ☐

Additional letter attached ☐

Set medical bar ☐

Donation instructions.....

MO's signature.....Date...../...../.....

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Figure 1.3 National Blood Service donor health check questionnaire, 2006. (Reproduced by kind permission of the National Blood Service.)

Box 1.1 **Donor consent: National Blood Service wording, 2006**

Donor consent should be signed in the presence of a member of National Blood Service staff:

1. I have today read and understood the blood safety and blood donation leaflets. I have been given the opportunity to ask questions and they have been answered.
2. To the best of my knowledge I am not at risk of infection or of transmitting the infections listed in the blood safety leaflet.
3. I agree that my blood donation will be tested for HIV and other conditions listed in the blood donation leaflet. I understand that if my donation gives a positive result for any of these tests I will be informed and asked to attend for further confirmatory tests and advice.
4. I understand the nature of the donation process and the possible risks involved as explained in the blood donation leaflet.
5. I agree to the National Blood Service holding information about me, my health, my attendances and donations, and using it for the purposes explained in the blood donation leaflet.
6. I give my blood to the National Blood Service to be used for the benefit of patients. This may be by direct transfusion to a patient or indirectly as explained in the blood donation leaflet.

Donor signature:

Date:

Box 1.2 **Donor safety: selection requirements**

Weight	more than 50 kg
Age	17th to 70th birthday (regular donor)
	17th to 66th birthday (new donor)
Haemoglobin	>124 g/L (females)
	>134 g/L (males)
Donation frequency	normally 16 weeks (minimum 12 weeks)
Donation volume	405–495 ml (target 470 ml)

Donation testing for markers of infection

Most of the infections that are transmissible by blood transfusion and present a risk to recipients in the UK are characterized by unapparent, chronic or persistent infection. A blood donor therefore presents as healthy, but is capable of passing on infection through the blood. Examples include hepatitis B and C viruses (HBV and HCV, respectively), HIV and human T cell lymphotropic virus (HTLV). These infections are all characterized by the existence of a persistent viraemia, and can be detected by appropriate screening tests.

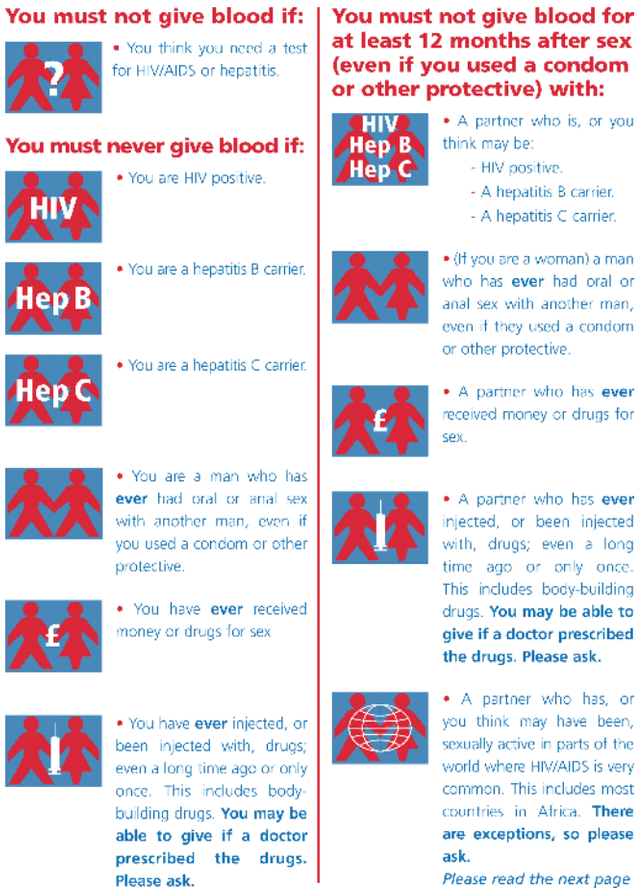

Figure 1.4 UK high risk exclusions as detailed on the National Blood Safety Service blood safety leaflet. (Reproduced by kind permission of the National Blood Service.)

Box 1.3 **Recipient safety: other exclusions**

Permanent
- Chronic infections, e.g. Chagas' disease, brucellosis
- History of malignant disease
- Ulcerative colitis
- Blood transfusion in UK since 1980 (vCJD risk)
- Recipients of human pituitary hormones (CJD risk)
- Recipients of corneal, scleral or dura mater grafts (vCJD risk)

Temporary
- Skin piercing
- Travel to malaria endemic countries
- Surgery
- Flexible endoscopy
- Acute infectious disease
- Immunization with live vaccines
- Dentistry

Currently, UK blood donations are screened for the presence of:
- hepatitis B surface antigen (HBsAg)
- HIV infection, through the use of combined antibody/antigen detection tests with supplementary genomic testing on pools of samples for HIV RNA in some areas
- HCV infection, through the use of tests to detect antibody supplemented by genomic testing for HCV RNA on pools of samples
- HTLV, through testing for antibody on pools of samples
- treponemal infection, through specific antibody detection assays.

All these tests are mandatory, and must be performed on every donation using nationally validated assays, with national 'working standard' samples and full process control.

Additional tests may be indicated for certain donors in particular circumstances. The necessity for these tests is usually decided after considering the epidemiology of the relevant infection and the risk presented from the local blood donor population. For instance, testing for antibodies to hepatitis B core (anti-HBc) is performed on donations in many developed countries, but it is not a routine screening test in the UK. It is used, however, for donors who have a higher risk of recent exposure to HBV infection through, for instance, skin piercing. It is also indicated for donors with a history of past HBV infection. A further example of such additional testing would be for evidence of malaria antibodies, as a marker of past exposure and possible continued infection. The decision whether to test depends upon a careful assessment of the potential donor's travel and residence history. A combination of history taking, postponement of donation until some months after the last possible exposure, and a negative malarial antibody test should ensure that malaria is not transmitted by blood transfusion. A second parasitic infection, Chagas' disease, is treated similarly.

There are other infections that may present a special risk to only a subset of transfusion recipients. An example is cytomegalovirus (CMV) infection, which is a particular hazard for immunosuppressed recipients. Despite routine leucodepletion of all UK blood components, which would be expected to substantially reduce the risk of transmission of cell-associated agents such as CMV, screening of selected blood donations continues to be performed to provide a supply of CMV 'safe' blood components for susceptible recipients. In areas of the world where CMV seroprevalence is very high, such a step would be impractical.

Despite careful blood donor selection and donation screening tests, infection may still be transmitted. Rarely, microbial agents that are not associated with persistent infection, and not therefore included in routine screening tests, can be transmitted by blood transfusion. This is usually because a donor gives blood during the incubation period, and examples have been reported for both hepatitis A and hepatitis E. Transmission of bacterial infection (unapparent donor bacteraemia) has also been reported on rare occasions but most bacterial transmissions are due to (exogenous) skin contaminants. Donation during the incubation period of an infection, i.e. during the 'window period' of infectivity, before reactive screening tests were developed, has also accounted for very small numbers of transmissions of those infections for which blood is now routinely screened, e.g. HIV.

Finally, there are infections for which there are no suitable screening tests; for the UK, vCJD is the most significant example. As virtually the whole of the UK population has been at risk of vCJD infection through diet in the past, the development of suitable blood tests and/or prion removal filters is proceeding (see Chapter 14). Thus, although blood transfusions in the UK are

exceedingly safe, there still remains a very small risk of transmission of infection, and this fact reinforces the need for testing to be combined with careful donor selection.

Serological testing

Serological tests are carried out on all donations to ascertain the blood group (A, B, AB or O) and for RhD typing; the results are checked against those previously obtained from that donor or by repeat typing with different batches of antibodies and test cells. Most UK centres also test for RhC, c, e, E and K antigens, and this information appears on the blood pack label. Blood units found negative for D antigen are labelled 'RhD negative'. With the monoclonal typing antibodies in current use, most weak and variant forms of D antigen are detected on direct testing. Those below the limit of detection with monoclonal anti-D are labelled as RhD negative since they are not considered to be immunogenic to a D-negative recipient. Extended testing to detect, for example, weak D or D^u in donors is not universally carried out. A proportion of the units is also typed for C^w, Fy^a, Fy^b, M, S, s, Jk^a and Jk^b, thus making the phenotyped red cell stocks readily available for alloimmunized patients in need of transfusion.

All donations are screened for clinically important red cell antibodies. Any donation found to have a high antibody titre should not be used for transfusion, although it may be a valuable source of red cell typing reagent. Low titres of antibodies should not automatically exclude a donation from therapeutic use as the antibody would be further diluted on direct transfusion. As well as this, about 90% of the plasma (and hence antibodies therein) from most donations is removed and the cells are resuspended in an additive solution such as saline adenine glucose mannitol (SAG-M); most of the remaining red cells just have most of the plasma removed (see Chapter 4). The comparatively unrefined antibody screening, possible on automated blood grouping machines, is therefore acceptable in the testing of blood donations, although it is not acceptable in the screening for antibodies of samples from potential recipients. An exception to this is the selection of blood for 'massive' transfusion of a neonate, when donor blood should be screened for antibodies using sensitive techniques.

Testing of group O blood for high titre haemolytic anti-A, anti-B and anti-AB is still carried out in some centres in the UK, so that plasma-rich components, such as platelet preparations, can be appropriately labelled. This practice should not be allowed to override the principle that a patient should receive blood of his/her own group and that group O donor blood (especially plasma-rich components) should not be given to patients of other groups except in an emergency.

In England, typing for human leucocyte antigen (HLA) or histocompatibility antigens is carried out on regular plateletpheresis donors, to satisfy the demand for HLA-matched platelets. Such platelets are used in the treatment of a severely thrombocytopenic patient who, because of many exposures to blood components, has developed multispecific antibodies to HLA antigens and has become refractory to random platelet transfusions. Normally, HLA-compatible donors would provide one or two adult doses of platelets by means of plateletpheresis. Typing for human platelet antigens HPA-1a and HPA-5b is also performed on regular plateletpheresis donors to supply compatible platelets for the transfusion of fetuses and infants affected by neonatal alloimmune thrombocytopenia. Occasionally, HPA-typed platelets are required for the transfusion of immunologically refractory patients with anti-HPA.

Further reading

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