Understanding the blood group system and blood transfusions

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Having a blood transfusion carries risks for patients. To minimise these risks, nurses must be aware of the ABO group system, components of blood and how they should be stored, handled, checked and administered. They must also be aware of possible adverse events during or after transfusion, how to monitor patients and how to deal with adverse events should they occur. All staff involved at any stage must be trained and aware of hospital policy and all actions must be accurately recorded to ensure the process is as safe as possible.

Although there are more than 20 genetically determined blood groups, for the purposes of transfusion blood falls into four main types, depending on the presence or absence of antigens and antibodies. These are known as ABO blood groups, and are determined by whether an individual’s red blood cells (RBCs) carry the A antigen, the B antigen, both A and B antigens or neither.

From early childhood, healthy individuals produce antibodies against the A or B antigens that are not present in their own blood (McElland, 2001). These antibodies attack and rapidly destroy ‘incompatible’ cells, so anti-A attacks RBCs of blood from groups A or AB, while anti-B attacks RBCs of groups B or AB. If incompatible RBCs are transfused into a patient, they are attacked and destroyed by the antibodies in the patient’s plasma. This will cause intravascular haemolysis to occur, which can initiate acute renal failure and disseminated intravascular coagulation (DIC). This reaction can be fatal.

The transfusion of even a few ml of ABO incompatible blood can cause serious problems and a reaction will occur within a few minutes. Table 1 shows the antigens and antibodies in the different blood groups and their compatibility and incompatibility with other groups.

**The rhesus factor**

The rhesus (RhD) antigen determines whether people are RhD positive (carry the RhD antigen) or RhD negative (absence of RhD antigen). Antibodies may develop in response to this antigen. This is clinically significant for RhD negative women carrying an RhD positive foetus.

**Blood component therapy**

All blood collected by the UK Blood Services is leuco-depleted, which means that white blood cells have been removed as a precaution against new variant Creutzfeldt-Jakob disease (vCJD) and no further filtration is needed before transfusion. However, a standard sterile blood administration set with a screen filter should always be used in transfusions. Drugs should never be added to a blood component transfusion under any circumstances.

**Red blood cells (erythrocytes)**

RBCs are disc-shaped cells with no nucleus. They contain haemoglobin, which allows oxygen to be transported. RBC transfusions are required in patients with acute or chronic anaemia to increase the oxygen-carrying capacity of their blood (Murphy et al, 2001). RBCs are separated from whole blood and a solution is added to preserve and nourish them. They have a shelf-life of 35 days and should be stored at 2–6°C. Once removed from the blood bank refrigerators their transfusion should commence within 30 minutes and be completed within four hours (McElland, 2001). Blood must never be stored in a domestic or ward fridge (British Committee for Standards in Haematology, 1999).

**Platelets**

Platelets are cell fragments that form an essential part of the blood clotting process. When blood comes into contact with any tissue (other than the lining of the blood vessel) as a result of injury, platelets stick together and form a plug that seals the wound. They then release chemicals that assist coagulation (Hand, 2001). Platelets are prepared in a concentrate with anticoagulant and some plasma, derived either from the pooling

**REFERENCES**


of platelets from four blood donations or from a single apheresis donation collected on a cell separator machine. They have a shelf-life of five days (seven days for some specially prepared concentrates) and are stored at 20–24°C in a platelet agitator. Platelets should never be stored in a refrigerator (McLelland, 2001).

Platelet transfusions are indicated for the prevention and treatment of haemorrhage in patients with thrombocytopenia or platelet function defects (BCSH and Blood Transfusion Taskforce, 2003). Once collected from the blood bank, they should be transfused immediately using a sterile blood administration set or a platelet infusion set. An adult therapeutic dose of platelets is usually transfused over 30 minutes.

**Fresh frozen plasma**

Plasma is the fluid in which the cellular components of blood are transported. Plasma also contains proteins, enzymes, electrolytes, hormones, nutrients and some waste products. Plasma is separated from whole blood and frozen within a few hours of the blood being collected from the donor to a core temperature of –30°C or below. Because it is frozen so quickly after collection it still contains high levels of coagulation proteins. The indications for transfusing FFP are limited. When transfused it can have unpredictable adverse effects (O’Saughnessy et al, 2004).

As an added precaution, FFP for babies and young children is treated with methylene blue, which inactivates viruses such as HIV and hepatitis C, to reduce risk of viral transmission to this vulnerable group. Children born on or after 1 January 1996 receive FFP imported from the US. This is an added precaution against vCJD transmission. vCJD is an unusual form of Creutzfeldt–Jakob disease (CJD) and is thought to be transmitted via contaminated beef products (O’Saughnessy, 2002). One of the most serious potential hazards of transfusion is a patient receiving AB0 incompatible blood. This is entirely preventable. Serious Hazards of Transfusion (SHOT) is the UK’s confidential, voluntary reporting system for serious adverse events and near misses associated with transfusion.

In its 2003 annual report (SHOT, 2003), transfusion of blood that is incompatible with the patient’s represented the highest proportion (75 per cent) of all the reports received. Multiple errors, for example where a patient receives incompatible blood because a sample has been mislabelled and this error is not picked up in checks at the blood bank or bedside, are a consistent feature of these incidents, and account for 52 per cent of all cases reported.

Errors can occur at all stages of the transfusion process, including prescribing, taking blood samples from the patient, in the transfusion laboratory, collecting blood from storage and at the bedside. However, by far the most common error in the transfusion process was failure of the bedside checking procedure (SHOT, 2003). The bedside check is the final chance to spot errors that may have occurred earlier in the transfusion process. If it is not carried out correctly, the possibility of incorrect blood being transfused is increased.

**Infusion of a bacterially contaminated unit**

This is likely to cause a severe acute reaction with rapid onset of hypotension, rigors and collapse (McLelland, 2001). It is important to store blood components correctly and to adhere to time limits for transfusion so that components are not damaged and bacterial proliferation does not occur.

It is also important to inspect each unit for leaks, signs of contamination, clumps, discoloration or anything that is unusual in appearance.

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**KEYWORDS**

- Medicine
- Blood groups
- Transfusion

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**REFERENCES**


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For related articles on this subject and links to relevant websites see [www.nursingtimes.net](http://www.nursingtimes.net)
Fluid overload
Acute left ventricular failure may occur if too much fluid is transfused or transfusion is too rapid. Patients with chronic anaemia are usually normovolaemic or hypervolaemic and may have signs of cardiac failure before transfusion. In these cases each unit will usually be given slowly with a diuretic and the patient should be closely observed (McLelland, 2001).

Severe allergic reaction or anaphylaxis
This rare but life-threatening complication usually occurs in the early part of the transfusion. There is a higher risk with components containing large volumes of plasma, such as FFP or platelets (McLelland, 2001).

Transfusion-related acute lung injury (TRALI)
This should be suspected when respiratory problems occur within six hours of a transfusion. It is thought to be caused by a reaction between white cell antibodies present in the plasma of the blood component and the patient’s white cells and presents as acute onset of shortness of breath and hypoxia during or soon after transfusion. TRALI is more common with plasma or platelets.

Nursing implications
A blood transfusion is, in effect, a liquid transplant – a transfer of tissue from one person to another. However, while transfusions save lives, they are not without risk (Ballard, 2003). Nurses have responsibility for many aspects of the transfusion process, such as taking and labelling blood samples, collection of blood from the blood bank and short-term storage in ward areas, checking, administering and documenting transfusions and monitoring of the patient. It is vital that they are thorough and methodical in all tasks related to transfusion to ensure patients’ safety, and must be aware of the steps necessary at each stage to safeguard the patients, which are listed below (BCSH, 1999).

In addition, transfusions should take place in areas where patients can be readily observed throughout the procedure and can alert ward staff if they experience any adverse effects.

Taking and labelling samples:
- Only bleed one patient at a time to minimise the risk of an error;
- Positively identify the patient by asking them for their full name and date of birth;
- Check these details match those on the patient’s identity wristband and the sample request form;
- Unconscious patients or those who are unable to communicate should have a unique patient identification number and their gender as minimum patient identifiers on an identity wristband;
- Label the sample tube immediately after the blood has been collected into it, by hand, with the patient’s full name, date of birth, gender and identification number and the date on which they were bled.

### BOX 1. SYMPTOMS/SIGNS OF ACUTE TRANSFUSION REACTIONS

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<thead>
<tr>
<th>Reaction</th>
<th>Symptom/Sign</th>
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<tr>
<td>Fever</td>
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### BOX 2. HOW TO RESPOND TO A SUSPECTED TRANSFUSION REACTION

- Stop the transfusion
- Call a doctor immediately
- Keep the line patent with an IV giving set and normal saline infusion
- Take and record temperature, pulse and blood pressure readings
- Check and record respiration rate and oxygen saturation
- Check the identity of the recipient against the details on the pack and on the compatibility report
- Be aware of and refer to local hospital policy

Collection from blood bank or satellite fridge:
- Ensure that the member of staff collecting the blood has documentation containing the patient’s identification details (collection slip, prescription chart or the patient notes);
- The member of staff must check the details on the above document and ensure that they match the details on the compatibility report form and the compatibility label on the unit;
- The member of staff should check that the blood group and unit number on the pack match those on the compatibility report form;
- When blood components are delivered to the ward or operating theatre an appropriately trained member of staff should be responsible for checking that the correct blood component has been delivered and that it is stored correctly and used within the correct timescale.

Informing the patient:
- The risks and benefits of blood transfusion should be explained to the patient, as should the alternatives that are available, such as preoperative iron therapy, intraoperative cell salvage and postoperative cell salvage;
- Patients receiving blood should be aware of the
importance of having the correct blood component transfused and the necessity of immediately reporting any adverse events to staff;

- The National Blood Service supplies a patient information leaflet that deals with the above issues.

Checking at the bedside:

- Either one or two members of staff (depending on hospital policy) are responsible for carrying out the identity check on the patient and the unit of blood at the patient’s bedside. One of these people must be a nurse or a doctor;
- Patients must be positively identified by being asked for their full name and date of birth if they are capable of responding;
- All patients undergoing transfusion must have an identification wristband with their full name, date of birth, gender and patient identification number clearly marked on it;
- The details on the wristband must be checked to confirm they are identical to those on the blood transfusion compatibility form, the compatibility label on the blood pack, the prescription chart and the medical notes;
- The blood group and unit number of blood must be identical to those on the transfusion compatibility form;
- The blood group on the unit must be compatible with the patient’s blood group as indicated on the compatibility label on the blood pack. The blood group does not have to be identical but it must be compatible, and in cases where the blood groups differ, a specific comment should have been made on the compatibility form to indicate that the blood is compatible;
- The unit must be checked for compliance with any special requirement on the prescription chart, for example, CMV seronegative or gamma irradiated;
- The unit must be checked to ensure it has not passed its expiry date, shows no signs of leakage, unusual colour, or haemolysis (or clumping or cloudiness in the case of platelet transfusions);
- The person carrying out the checks must sign the blood transfusion compatibility form and prescription chart;
- If any discrepancies are found during the bedside checks, the unit should not be transfused and the blood bank staff should be informed. The unit and compatibility form should then be returned to the blood bank.

Monitoring during transfusion:

- Start and finish times should be recorded for each unit so that adverse events can be correctly identified;
- Vital signs should be measured and recorded before the start of each unit of blood or component and at the end of each transfusion episode. These observations should be recorded separately from routine observations so that they are clearly related to the transfusion;
- The patient’s temperature and pulse should be recorded 15 minutes after the start of each unit;
- Visual observation is the best way of assessing a patient’s condition during transfusion;
- Further observations are necessary only if the patient becomes unwell or shows signs of a transfusion reaction;
- Unconscious patients are more difficult to monitor for signs of a reaction to the transfusion. Routine observation should continue and transfusion reactions should be considered if there is a change or deterioration in the patient’s condition.

Documentation:

- The blood transfusion compatibility report, signed by the person checking and administering the transfusion, should be kept in the patient’s notes;
- A permanent record of the administration of the blood or components and any relevant observations should be kept in the patient’s notes;
- The blood transfusion prescription chart and the nursing observations made during the transfusion episode should be retained in the patient’s notes;
- A record of the reason for the transfusion and its result should be kept in the patient’s notes;
- A record of any adverse events occurring during or after transfusion and the management of those events should be kept in the patient’s notes. Any adverse events must be reported to the blood bank staff.

Conclusion

It is every nurse’s responsibility to ensure that blood is correctly sampled, handled, stored, checked and administered. Hospitals should have policies and protocols in place to ensure that transfusion is safe and blood is not wasted (Department of Health, 2002), and all staff involved in any part of the process should be fully trained and aware of these.

In addition, patients should be well informed prior to transfusion and monitored throughout the procedure, and records should be accurate. If there is any doubt about any aspect of the transfusion, nurses should check with the blood bank manager or hospital transfusion specialist before commencing the transfusion to ensure their practice is safe.

GUIDED REFLECTION

Each week Nursing Times publishes a guided reflection article to help you with your CPD. After reading the article use the following points to help you write your reflection:

- Describe why you read this article and how you can apply it to the patient group you work with;
- Outline the key points of the article;
- Describe how the article will help you to ensure the safety of your patients who have a transfusion;
- Consider how you can share this learning with your colleagues and what else you might do to extend your learning.

REFERENCES
