Understanding Blood Groups and Antibodies

Debbie Asher
EPA Network Transfusion Manager
To cover:

• What is a red cell antigen?

• What is a red cell antibody?

• What do they mean for blood provision?

• Why are haematology patient samples the most challenging?
An antigen

• An antigen can be defined as a **substance** that, when introduced into the circulation of an individual lacking that antigen, can **stimulate the production of a specific antibody**.

• Red cell antigens
Blood group antigens

- Band 3
- GPA
- MNS
- GPB
- MNS Rh Polypeptide
- Rh Glycoprotein
- Lipid bilayer
- Spectrin tetramer
- Actin
- P55

Related molecules:
- Ankyrin
- Actin
- P55

Diagram shows the distribution of blood group antigens on the surface of a red blood cell, including their interaction with the lipid bilayer and other cellular components.
ABO antigens

Example:
ABO- Blood group system
A close up
Inheritance

Phenotype

Genotype

Phenotype

Genotype

Phenotype

Genotype

Phenotype

Genotype

Phenotype

Genotype
An antibody

• An antibody can be defined as a serum protein (i.e. an immunoglobulin with specific antigen binding sites) produced as a result of the introduction of a foreign antigen, that has the ability to combine with (and, in many cases, destroy) the cells carrying the antigen that stimulated its production.
Red cell antibodies (allo-antibodies)

Produced when exposed to foreign blood:

- Previous transfusion of blood/components
- Fetal maternal haemorrhage during pregnancy or at delivery
Antibodies produced by lymphocytes
Antibodies - IgG

Immunoglobulin IgG subclasses

IgG1  IgG2  IgG3  IgG4
ABO system

Red Cells (Antigens)
- A
- B
- O
- AB

Plasma (Antibodies)
- Anti-B
- Anti-A
- Anti-A, Anti-B
- Anti-A,B
- None
## Choice of group – platelet transfusion

### Platelet selection by recipient ABO group

<table>
<thead>
<tr>
<th>Recipient Group</th>
<th>O</th>
<th>A</th>
<th>B</th>
<th>AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Choice</td>
<td>O</td>
<td>A</td>
<td>B</td>
<td>AB</td>
</tr>
<tr>
<td>2nd Choice</td>
<td>A or B</td>
<td>AB or B* or O*†</td>
<td>AB or A* or O*†</td>
<td>A* or B* or O*†</td>
</tr>
</tbody>
</table>

* components tested negative for high-titre anti-A and/or anti-B and those suspended in PAS should be used
† the use of group O apheresis platelets for non group O neonates and children is not recommended because of the risk of haemolysis


ABO incompatible transplants introduce either:

- New red cell antigens (A donor, O recipient) - major mismatch
- New red cell antibodies (O donor, A recipient) – minor mismatch
- Both (A donor, B recipient)
Transfusion support for recipients of ABO incompatible HSC components

<table>
<thead>
<tr>
<th></th>
<th>Recipient</th>
<th>Donor</th>
<th>Packed RBC</th>
<th>Platelet / FFP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABO Major</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>O</td>
<td>A</td>
<td>O</td>
<td>A, AB</td>
</tr>
<tr>
<td>O</td>
<td>O</td>
<td>B</td>
<td>O</td>
<td>B, AB</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>AB</td>
<td>A, O</td>
<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>AB</td>
<td>B, O</td>
<td>AB</td>
</tr>
<tr>
<td><strong>ABO Minor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>O</td>
<td>A, O</td>
<td>A, AB</td>
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<tr>
<td>B</td>
<td>B</td>
<td>O</td>
<td>B, O</td>
<td>B, AB</td>
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<td>AB</td>
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<td>A</td>
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<td>AB</td>
</tr>
<tr>
<td>AB</td>
<td>AB</td>
<td>B</td>
<td>AB</td>
<td>AB</td>
</tr>
<tr>
<td><strong>ABO Major and Minor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>O</td>
<td>AB</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>A</td>
<td>O</td>
<td>AB</td>
</tr>
</tbody>
</table>
Pre-transfusion compatibility testing

- Relevant clinical details
- Transfusion/transplant history
- Blood group – ABO and RhD
- Antibody screen
Communication is key

**IRRADIATED AND SPECIALIST BLOOD COMPONENTS COMMUNICATIONS DOCUMENT**

This section ONLY is to be completed by a member of the Clinical Team and then sent to the Transfusion Laboratory for the remainder of the form to be completed.

<table>
<thead>
<tr>
<th>Affix Addressograph here or complete the following details:</th>
<th>Referring hospital:</th>
<th>ABO and RhD Group Details</th>
<th>Specialist Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient First and family Name:</td>
<td>Specialist Treatment Hospital</td>
<td>Donor Group</td>
<td>Irradiated: Yes / No</td>
</tr>
<tr>
<td>Date Of Birth:</td>
<td>Diagnosis:</td>
<td>Patient Group</td>
<td>CMV Neg: Yes / No</td>
</tr>
<tr>
<td>NHS / Hospital Number:</td>
<td>Specialist Treatment required or received:</td>
<td>Patient Informed of Specialist Requirements?: Yes / No</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>Signed: ___________________</td>
<td>Print Name: ___________________</td>
<td></td>
</tr>
<tr>
<td>Date: / /</td>
<td>Contact number / Bleep ___________________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following sections are ONLY to be completed by the Transfusion Laboratories

Please document below the ABO and D (where applicable) group of the blood components that the patient currently requires

<table>
<thead>
<tr>
<th>Red cells:</th>
<th>Platelets:</th>
<th>FFP:</th>
</tr>
</thead>
</table>

**RBC Antibodies** | **Specialist Requirements** | **Additional Requirements**

<table>
<thead>
<tr>
<th>Historical Antibodies:</th>
<th>HLA / HPA abs:</th>
<th>Yes / No</th>
<th>RBC Phenotype:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Antibodies:</td>
<td>Specificity</td>
<td>Washed RBCs:</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

DAT

Washed Platelets: | Yes / No |

Signed: ___________________ | Print Name: ___________________ | Date: ___________________ |

Copy of completed form to be sent by Secure Fax or scanned copy emailed by Laboratory of identifying hospital to Shared Care Hospital Laboratory

Date Fax sent: / / | Signed: ___________________ | Print Name: ___________________ |

Print Name: ___________________ | Specialist requirements input into Shared Care Hospital LIMS computer: Yes / No | Date: / / |
Agglutination
Blood grouping
Check group
Transplant patient
Pre-transfusion compatibility testing

- History and clinical details checked
- Blood group – ABO and RhD
- Antibody screen - no antibodies detected
- Issue blood
Pre-transfusion compatibility testing

• To ensure that the specimen used for compatibility testing is representative of the patient’s current immune status testing should be performed using blood taken no more than 3 days in advance of the actual transfusion, when the patient has been transfused or pregnant in the preceding 3 months.

BCSH guidelines, Transfusion Medicine, 2013, 23, 3-35
Antibody production
Pre-transfusion compatibility testing

- History and clinical details checked
- Blood group – ABO and RhD
- Antibody screen – antibody detected
- Antibody identification
- Select blood
- Crossmatch
Autoimmune Haemolytic Anaemia

• Antibody against own red cells - autoantibody
• Reacts to all red cells tested in the laboratory
• Major difficulty in determining whether there is also an alloantibody (ies)
• Samples sent to a NHSBT Reference Centre
DAT / DCT

• Direct antiglobulin test
• Direct Coombs test

• Looks for antibody bound to red cells ‘in vivo’ ie
  – an antibody against self – AIHA, post transplant (HDFN)
  – an antibody against transfused cells – incompatible transfusion
Reasons haematology patients are challenging

• HSCT – need to be aware of recipient and donor blood groups
• Multi-transfused – more likely to have antibodies
• Transfused in the out patient setting – need careful planning
• AIHA – need the help of the reference centre and even more careful planning!
Communication is key

- Laboratory inform clinical area of difficulty
- Clinical area clearly document difficulty in patient’s notes
- Come up with a clear plan for these patients