Demystifying Blood Groups

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Patient Blood Management Practitioner Education Team
Donation to blood component

http://www.transfusionguidelines.org.uk/
Blood groups – the basics

• Karl Landsteiner discovered the ABO blood groups in 1901
• Levine and Stetson discovered the Rh system in 1939
  – 85% Rh positive
  – 15% Rh negative
• What determines our blood group?
  – Antigens, if any, will be on the surface of red blood cells
  – Antibodies, if any, will be present in the plasma
# ABO blood groups

<table>
<thead>
<tr>
<th>Patient blood group</th>
<th>Antigens on red cell</th>
<th>Antibodies in plasma</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>Anti-B</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>Anti-A</td>
</tr>
<tr>
<td>O</td>
<td>None</td>
<td>Anti-A and Anti B</td>
</tr>
<tr>
<td>AB</td>
<td>A and B</td>
<td>None</td>
</tr>
</tbody>
</table>

Antibodies can be naturally occurring or due to exposure through pregnancy or transfusion.
Why are antibodies important?

<table>
<thead>
<tr>
<th>TYPE A</th>
<th>TYPE B</th>
<th>TYPE AB</th>
<th>TYPE O</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC</td>
<td>Surface antigen A</td>
<td>Surface antigen B</td>
<td>Neither A nor B surface antigens</td>
</tr>
<tr>
<td>PLASMA</td>
<td>Anti-B antibodies</td>
<td>Anti-A antibodies</td>
<td>Anti-A and anti-B antibodies</td>
</tr>
</tbody>
</table>

**B**

- **Surface antigens**: Red blood cells (RBC) have surface antigens (A or B).
- **Opposing antibodies**: The plasma contains antibodies (anti-A or anti-B) that react with the surface antigens.
- **Agglutination (clumping) and hemolysis**: When antibodies react with their specific antigens, it leads to clumping (agglutination) and hemolysis (rupture of red blood cells).
Importance of antibodies

- There are currently 35 known blood groups systems (IBGRL 2014)
- The most clinically important red cell antigens belong to the ABO and Rh blood group system
- There are over 350 different types of antigens – which have the potential to produce antibodies
- Not all antibodies are clinically significant
Blood group distribution

English

SE Asians (Laos)

Indians

Africans (Zimbabwe)

Native Americans

Australian Aborigines

RBC distribution and use

O NEG
7% UK POPULATION
12.2% CURRENT HOSPITAL DEMAND

Total RBC
Total RBC issues are falling however O NEG issue remains constant

Total RBC DECREASE CONSTANT DEMAND
Blood samples for transfusion

• Group and save / group and screen / group and hold
  – To determine the ABO and RhD groups and the plasma is screened for the presence of antibodies
  – British Committee for Standards in Haematology recommend a second sample should be requested to confirm the ABO group of a first-time transfused patient, provided this does not impede the delivery of urgent red cells or components (BCSH, 2012)

• Serological crossmatch
  – Between the patient’s plasma and a sample of red cells from the units of blood selected for transfusion

• Transfusion of ABO incompatible blood is now classed as a ‘never event’ (DH, 2011)
What could go wrong?
What would be the consequence?

<table>
<thead>
<tr>
<th>Error</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Wrong blood in tube</td>
<td>• Wrong patient is transfused</td>
</tr>
<tr>
<td>• Antibody not detected</td>
<td>• Transfusion reaction / death</td>
</tr>
<tr>
<td>• Wrong component given</td>
<td>• Transfusion reaction</td>
</tr>
<tr>
<td></td>
<td>• Incorrect treatment</td>
</tr>
</tbody>
</table>
How could you prevent this?
Case scenarios and link to on-line tool

• https://www.nobelprize.org/educational/medicine/lands
teiner/index-oldgame.html
SHOT Cumulative data: 18 years n=14822

- UCT: Unclassifiable complications of transfusion
- PTP: Post-transfusion purpura
- TTI: Transfusion-transmitted infection
- TAD: Transfusion-associated dyspnoea
- CS: Cell salvage
- ATR: Acute transfusion reaction
- TAGvH: Transfusion-associated graft vs host disease
- TRALI: Transfusion-related acute lung injury
- ALlo: Alloimmunisation
- TACO: Transfusion-associated circulatory overload
- HTR: Haemolytic transfusion reaction
- ADU: Avoidable, delayed or undertransfusion
- HSE: Handling and storage errors
- Anti-D: Anti-D immunoglobulin errors
- IBCT: Incorrect blood component transfused

Legend:
- Blue bars: Cumulative to 2013
- Red bars: 2014

Transfusion reactions which may not be preventable

Possibly or probably preventable by improved practice and monitoring

Adverse incidents due to mistakes
Adverse clinical events – WHEN?

- **Immediate** and life-threatening: ABO incompatibility; anaphylaxis
- **Hours:** pulmonary complications, bacterial infections, transfusion reactions
- **Days:** Haemolytic reactions
- **Late** (months or years): viral infections; iron overload
Case 1

- A 56 year old man with acute myeloid leukaemia is having a platelet transfusion
- 5 minutes into the transfusion he feels unwell
- His temperature has increased to 40°C
- He is sweating with severe hypotension
What is the most likely cause?
(Choose 1)

1. Allergic reaction
2. Haemolytic reaction
3. Infection in central venous line
4. Infection in platelet bag
What to do for an immediate transfusion reaction?

- Stop the transfusion, maintain IV access with saline and check the bag and patient ID
- Rapid medical assessment
- Inform the transfusion laboratory
- Blood culture and return blood bag to lab
- Renal function
  - Monitor fluid balance (input and output)
  - Collect first and subsequent urine samples
Case 2

- An elderly male patient received the first unit of FFP to correct a coagulopathy

- Half-way through the unit, he developed marked hypotension (from 100/60 to 50/20) and a widespread urticarial rash and shortness of breath with wheeze
What would you do?
(Choose 2)

1. Discontinue the transfusion
2. Continue the transfusion more slowly
3. Give hydrocortisone and piriton
4. Give adrenaline
5. Try a different unit
Acute transfusion reactions

- Allergic or anaphylactic reactions are unpredictable and usually occur early
- This is why all patients having blood products must be monitored
- Adrenaline (IM) is the treatment of choice and should be available in all areas where transfusions take place
Case 3

- An elderly woman with cirrhosis, ischaemic heart disease and a coagulopathy had an elective knee replacement
- She was transfused with 2 units FFP and 2 doses of platelets to cover removal of lines and epidural
- 30 mins after completing the transfusion she became suddenly breathless and hypoxic with signs of heart failure
Case 3 cont.

- The CXR showed bilateral shadowing and she was known to have impaired left ventricular function.
What is the most likely diagnosis?
(Choose 1)

1. TACO (transfusion-associated circulatory overload)
2. Chest infection
3. Acute myocardial infarction
4. TRALI (Transfusion-associated acute lung injury)
Severe dyspnoea without shock

- Consider TRALI or TACO
- Check airway and give oxygen
- Get expert medical assessment
- CXR and oxygen saturation
Case 3 cont.

- She was ventilated for 5 days and made a full recovery
- She was also treated with diuretics and IV fluids
- She was investigated for TRALI and this was confirmed by serological evidence of concordant HLA antibodies in one female donor of the apheresis platelets
So what is the greatest risk of transfusion?