BLOOD PHYSIOLOGY

Lecture 3

BLOOD TYPES AND BLOOD TRANSFUSION
Objectives

1. Describe the basis of blood typing
2. Know the ABO and Rh systems for blood typing and their clinical significance.
3. Describe incompatibilities in ABO and Rh systems.
4. Know the different types of blood transfusions and their complications (transfusion reactions).
5. Describe the basis of blood typing and cross-matching tests for a safe blood transfusion.
Basis of Blood grouping or Typing
(Multiplicity of Antigens in the blood cells)

• At least 30 commonly occurring antigens have been found on the cell membrane of RBCs.
• These can cause Ag-Ab (antibody) reaction if mixed with plasma that contain Ab against these Ag.
• According to presence or absence of these antigens blood is classified into several groups or types.
• Two groups of Ag can cause transfusion reactions more than others: ABO and Rh systems of Ag.
ABO System for Blood Typing
A and B Antigens - Agglutinogens
ABO blood types

Relative frequency of different blood types:

- O  47%
- A  41%
- B  9%
- AB 3%
### Agglutinins (antibodies)

- They are naturally occurring antibodies.

<table>
<thead>
<tr>
<th>Blood type</th>
<th>Agglutinogen on RBC</th>
<th>Agglutinin 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>AB</td>
<td>A and B</td>
<td>None</td>
</tr>
<tr>
<td>O</td>
<td>None</td>
<td>Anti-A and Anti-B</td>
</tr>
</tbody>
</table>
Rh System for Blood Typing

• If type D antigen is present on RBC → Rh +ve
• Differences between ABO and Rh Ab?
• Anti-Rh antibodies are not naturally occurring Ab.
• Previous exposure to Rh antigen is required.
  • Rh +ve blood transfusion.
  • Rh –ve women pregnant with Rh +ve baby.
• Anti-Rh Ab can cross the placenta.
Haemolytic Disease of the Newborn (HDN)

- Rh incompatibility → Erythroblastosis Fetalis (HDN).
- Rh –ve lady marrying Rh+ve man.
- If baby is Rh+ve, fetal RBC leaks to maternal circulation during placental separation (delivery or abortion).
- Mother starts to make anti-Rh Ab.
- Next pregnancy with Rh+ve baby → anti-Rh Ab pass to baby and cause agglutination and hemolysis of his RBC.
(a) First pregnancy

Rh⁻ mother

Placenta

First Rh⁺ fetus

Rh⁺ antigens

(b) Between pregnancies

Anti-Rh antibodies

(c) Second pregnancy

Second Rh⁺ fetus
Prevention

• Anti-D antibodies (RhoGam) injection given to Rh –ve mothers after delivery of Rh +ve baby.
1 minute Quiz

• How does a RhoGam injection (anti-D antibodies) prevent HDN in a future pregnancy with an Rh +ve baby?
(Fetal red cells) + RhIG → Immune system Not stimulated
No maternal immunization
No anti-D produced in subsequent infant
No HDN in subsequent infant
BLOOD TRANSFUSIONS
Blood Transfusion

• Indications
  1. Haemorrhage
  2. Loss of one element of blood as in anemia, leucopenia and purpura

• Types:
  – Heterologus → from other person of the same species
  – Autologous → from the same person
Transfusion Reactions resulting from mismatched blood types

• Agglutination and delayed hemolysis of donor’s RBC (or immediate intravascular hemolysis) → Jaundice
• Renal failure:
  – Renal tubular blockage by hemoglobin
donor type A

anti-B

recipient type B

anti-A

clumping of donor cells

donor cells burst

kidney damage

small vessels blocked

reduced blood supply
Pre-transfusion Tests

• For a safe blood transfusion, the following tests are done:
  – Blood typing
  – Cross-matching
Blood Typing
Blood typing, showing agglutination of cells of the different blood types with anti-A or anti-B agglutinins in the sera

<table>
<thead>
<tr>
<th>Red blood cell types</th>
<th>Anti-A serum</th>
<th>Anti B serum</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>AB</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Blood Groups

A

B

D

A +

A -

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Blood Groups

A  B  D

B +

A  B  D

B -
Blood Groups

AB +

AB -
Blood Groups

O +

O -
X-matching

• Once patient’s blood type is known, donor blood of the same ABO and Rh type is selected.

• Possible donor RBC’s are mixed with the recipient’s serum. If no agglutination, no Ab in recipient blood will attack donor’s RBCs.
Finally…

• Write down the muddiest point.

• Summarize the lecture in your own words.
Summary

• What are the basis of blood type classification into O-A-B and Rh blood types?
• What are the differences in the agglutinins (antibodies) against the O-A-B and Rh system agglutinogens (antigens)?
• What is the cause of HDN?
• What are the consequences of an incompatible blood transfusions (transfusion reactions)?
• What laboratory tests are done to insure a safe blood transfusion?
Thank You for Not Listening