ABO Blood Grouping & Rh Groups

BCH 471
Blood Group Substances

- The differences in human blood are due to the presence or absence of certain molecules called **antigens** and **antibodies**.

- The **antigens** are located on **the surface of the red blood cells**

- Antigens are also found in a wide variety of tissues and biological fluids such as saliva, milk, seminal fluid, urine, and gastric juice.

- The **antibodies** are proteins in the **blood plasma** to attack foreign antigens, resulting in clumping (agglutination)
ABO Blood Type System

- The ABO blood type system is the major blood type classification system.
- The four blood types in the ABO system (A, B, AB, and O) refer to different versions of oligosaccharides which are present on the surface of RBCs.

<table>
<thead>
<tr>
<th>People with:</th>
<th>Have:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A blood</td>
<td>Type A carbohydrate molecules on their red blood cells</td>
</tr>
<tr>
<td>Type B blood</td>
<td>Type B carbohydrate molecules on their red blood cells</td>
</tr>
<tr>
<td>Type AB blood</td>
<td>Both type A and type B carbohydrate molecules on their red blood cells</td>
</tr>
<tr>
<td>Type O blood</td>
<td>Neither type A nor type B carbohydrate molecules on their red blood cells</td>
</tr>
</tbody>
</table>
Importance of The ABO System

- Blood group antigens must be determined to secure a safe practice of **blood transfusion**.
- They are also useful in determining **familial relationships** in forensic medicine.
Genetics of Blood Types

• Your blood type is established before you are born, by specific GENES inherited from your parents.

• You have two copies of this gene, one inherited from your MOTHER and the other inherited from your FATHER.

<table>
<thead>
<tr>
<th>father</th>
<th>mother</th>
<th>alleles</th>
<th>blood type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A+A = A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>A+O = A</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>A+B = AB</td>
<td>AB</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>B+B = B</td>
<td>B</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>B+O = B</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>O+O = O</td>
<td>O</td>
</tr>
</tbody>
</table>

Codominance
is a condition in which the alleles of a gene pair in a heterozygote are fully expressed thereby resulting in offspring with a phenotype that is neither dominant nor recessive.
Blood Types

- There are **3 alleles or genes** for blood type: A, B, & O.
- Since we have 2 genes, there are **6 possible combinations**.

**The ABO Blood System**

<table>
<thead>
<tr>
<th>Blood Type (genotype)</th>
<th>Type A (AA, AO)</th>
<th>Type B (BB, BO)</th>
<th>Type AB (AB)</th>
<th>Type O (OO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Blood Cell Surface Proteins (phenotype)</td>
<td>A agglutinogens only</td>
<td>B agglutinogens only</td>
<td>A and B agglutinogens</td>
<td>No agglutinogens</td>
</tr>
<tr>
<td>Plasma Antibodies (phenotype)</td>
<td>b agglutinin only</td>
<td>a agglutinin only</td>
<td>No agglutinin</td>
<td>a and b agglutinin</td>
</tr>
</tbody>
</table>
Blood transfusions – who can receive blood from whom?

A antigen
Red blood cell
Blood type A
Blood type B

Blood type AB
Universal recipient
Blood type O
Universal donor

O
A
B
AB
Rhesus Blood Group

- First studied in rhesus monkeys.

- Is the second most significant blood group system in human transfusion.

- The **D antigen (RhD)** is the most important.

  - If it is present on RBCs’ surface, the blood is **RhD positive** (~80% of the population), if not it's **RhD negative**.

- So, for example, some people in group A will have it, and will therefore be classed as **A+** (or **A positive**), while the ones that don't, are **A-** (or **A negative**) and so it goes for groups B, AB and O.
Rh Blood Group Transfusion

- A person with Rh+ blood can receive blood from a person with Rh- blood without any problems.
- A person with Rh- blood can develop Rh antibodies in the blood plasma if he or she receives blood from a person with Rh+ blood, whose Rh antigens can trigger the production of Rh antibodies.
## Red Blood Cell Compatibility Table

<table>
<thead>
<tr>
<th>Recipient</th>
<th>O-</th>
<th>O+</th>
<th>A-</th>
<th>A+</th>
<th>B-</th>
<th>B+</th>
<th>AB-</th>
<th>AB+</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>O+</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>A+</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>B-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>B+</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>AB-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>AB+</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Hemolytic Disease of The Newborn (HDN)

• Also called, Erythroblastosis Fetalis
• **Mother** is Blood type Rh-, **Father and fetus** are Rh+
• First pregnancy = sensitization at delivery due to hemorrhage
• Second pregnancy = **Mother produce anti-Rh IgG** antibodies that cross placenta to **attack fetal RBCs** leading to hemolysis
Principle Of Test

Type B blood gp  Anti B antibodies  Agglutination  Hemolysis

Seen as the picture
Practical Part
Objectives

• To determine the blood group according to the ABO system.

• To test for the availability of the Rh factor (D antigen).
RESULTS

Blood being tested

Type AB (contains agglutinogens A and B; agglutinates with both sera)

Type A (contains agglutinogen A; agglutinates with anti-A)

Type B (contains agglutinogen B; agglutinates with anti-B)

Type O (contains no agglutinogens; does not agglutinate with either serum)

HOW TO READ YOUR RESULTS

BLOOD TYPE | ANTI-A | ANTI-B | ANTI-D | CONTROL
---|---|---|---|---
O-POSITIVE | ![Image] | ![Image] | ![Image] | ![Image]
O-NEGATIVE | ![Image] | ![Image] | ![Image] | ![Image]
A-POSITIVE | ![Image] | ![Image] | ![Image] | ![Image]
A-NEGATIVE | ![Image] | ![Image] | ![Image] | ![Image]
B-POSITIVE | ![Image] | ![Image] | ![Image] | ![Image]
B-NEGATIVE | ![Image] | ![Image] | ![Image] | ![Image]
AB-POSITIVE | ![Image] | ![Image] | ![Image] | ![Image]
AB-NEGATIVE | ![Image] | ![Image] | ![Image] | ![Image]
INVALID | ![Image] | ![Image] | ![Image] | ![Image]