BYJU'S EXAM PREP

BLOOD GROUPS

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Blood Groups

Various glycoproteins and lipoproteins are embedded in the surfaces of red blood cells. These proteins are inherited, and their structures may vary from one individual to another. If during a transfusion an individual receives blood containing RBCs with proteins that the individual does not carry, these proteins may be recognized as foreign antigens by the immune system. If so, antibodies have been produced that bind to the antigens and cause agglutination (clumping) and subsequent destruction of the foreign RBCs.

There are over 30 common groups of RBC proteins, referred to as antigens, isoantigens, or **agglutinogens** (which is the preferred term). Generally, each group is controlled by a single gene, and for each gene, two alleles, or forms, of the gene are inherited (one allele from each parent). Each blood group gene may have two or more different alleles in the population. Although not all blood group proteins stimulate the immune response, two important ones do:

a. ABO blood group. The gene responsible for this group has three alleles. One allele produces an "A" agglutinogen, a second produces a "B" agglutinogen, and a third produces no agglutinogens ("O"). Because individuals inherit two alleles, individuals may be of the A blood type, inheriting two A alleles (AA) or an A and an O allele (AO); the B blood type (BB or BO); the AB blood type (AB); or the O blood type (OO). The immune response is activated when an individual receives a transfusion with blood carrying nonself agglutinogens. For example, the immune system would respond if a person with A blood type (either AA or AO) receives the blood of the B or AB blood type, but not of the O type. (The O type does not carry any foreign agglutinogens.)

b. Rh blood group. This is a complex group defined by agglutinogens produced by three different genes. Each gene has two (or rarely, three) alleles. Because of the close linkage of the genes (they are positioned close to one another on the same chromosome), the expression of the group can be evaluated as if it were a single gene with two alleles, an Rh^+ allele (producing the Rh agglutinogen) and an Rh^- allele (producing no Rh agglutinogen). Thus, individuals are either Rh^+ if they inherit one or two Rh^+ alleles or Rh^- if they inherit two Rh^- alleles. The Rh factor is typically called the D agglutinogen. It was originally found on the red blood cells of Rhesus monkeys (hence the "Rh" factor).

Bombay blood group (HH blood group)

- Bombay blood group is the rarest blood group. First found in Bombay (Mumbai) in India, hence called Bombay blood group.
- The Bombay Phenotype was first reported by Bhende in 1952 in Bombay, India.

- This very rare phenotype is generally present in about 0.0004% (about 4 per million) of the human population, though in some places such as Mumbai (formerly Bombay) locals can have occurrences in as much as 0.01% (1 in 10,000) of inhabitants.
- It is also called the HH group. The peculiarity is that they do not express the H antigen. As a result, they cannot form A antigens or B antigens on their red blood cells.
- When we say someone has blood group A, it means that the person has antigen of type 'A' and antibody of type 'B' in his/her blood.
- People with AB have both antigens A and B in their blood and no antibodies.
- People with O blood group have only antibodies A and B and no antigens.
- However, what is not generally known is that all these groups have an antigen H in the blood as well. There are very few people who do not have this antigen H also in their blood.
- Instead, they have antibody H because of which no other blood can be given to them.
- The function of the H antigen, apart from being an intermediate substrate in the synthesis of ABO blood group antigens, is not known, although it may be involved in cell adhesion.
- The H gene appears to be necessary for the formation of A and B Ags. It is very common 99.9% of all individuals have an HH or Hh genotype.
- The allele h is very rare and does not produce the L-fucose transferase necessary for the formation of the H-Structure.
- The genotype (hh) or H null is extremely rare and is known as the Bombay Phenotype or O_h.
- The *H* gene codes for an enzyme (fucosyltransferase) that adds Fucose to the terminal sugar of a Precursor Substance.
- H antigen is the foundation upon which A and B antigens are built.
- *A* and *B* genes code for enzymes that add an immunodominant sugar to the H antigen.
- *O* allele does not code a functional enzyme
- Bombay cells cannot be converted to group A or B by the specific transferases.
- This supports the concept that the H structure serves as the acceptor molecule or precursor substance for the product of the A or B gene-specified transferases.

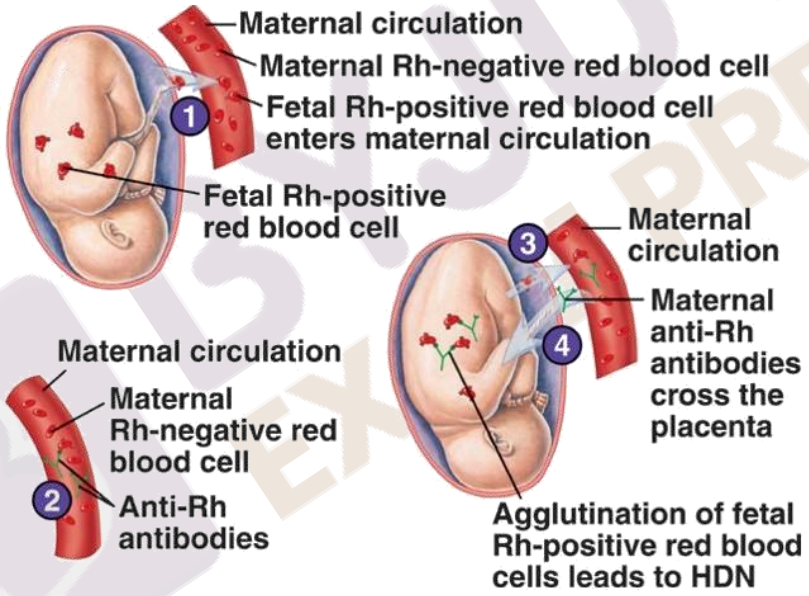
Blood Groups (Antigens and Antibodies)		
Blood Group	**Antigens**	**Antibodies**
A	A,H	B
B	B,H	A
AB	A,B,H	-
O	H	A,B
Bombay Blood Group	-	A,B,H

- Bombay individuals lack all normal expressions of the A, B, or O genes they inherited.
- The Bombay Phenotype Red Cells are devoid of normal AB, H Ags.
- Fail to react with anti- A, anti -B, and anti -A, B and anti H.
- Bombay Serum contains anti-A, -B and anti-H.
- The Bombay anti-H is active over a wide thermal range. It is an IgM antibody that can bind complement and cause red cell lysis.
- Because the H Ag is common to all ABO blood groups, Bombay blood is incompatible with all ABO donors.
- In routine forward grouping, using anti-A, anti-B, and anti-AB; the Bombay would phenotype as an O blood group.
- However, transfusing normal group O would cause immediate cell lysis by the potent anti-H of the Bombay individuals.
- Thus, *only* blood from another Bombay individual can be transfused to a Bombay recipient.

Erythroblastosis Fetalis

- Testing to see if we are Rh positive or Rh negative is routinely done during pregnancy, and for blood donors and for people receiving a blood transfusion.
- If a mother is Rh-negative but her baby is Rh-positive (which can happen if the father is Rh positive), the mother could produce antibodies that fight the baby's red blood cells
- This can happen if blood from the unborn baby enters the mother's circulation.
- When there is a risk of this happening (threatened miscarriage, termination, chorionic villus sampling (CVS), abdominal trauma, at delivery), an injection called **anti-D** can be given to the mother to help prevent these antibodies against Rh-positive blood from being produced.

- Rh antigens of the foetus **the Rh-ve blood do not get exposed** to of the mother in **First pregnancy** as the t blood are well separated by **PLACENTA.**
- **Due to minor RUPTURING OF CHORIONIC VILLI OF PLACENTA, a** small amount of maternal and foetal blood can get mixed **DURING FIRST PREGNANCY.**
- During delivery of first child, there is the possibility of Exposure of the Maternal Blood to small amounts of the RH+ve blood of the Foetus.
- In such a case, **MOTHER START PREPARING ANTIBODIES** against Rh in her blood.
- In the case of her **subsequent pregnancies, the Rh antibodies from the mother (Rh-ve) can Leak into the blood of the foetus (Rh+ve) and destroy the foetal RBCs.**
- In order to **compensate for lost RBCs, Foetus produces more and more immature RBCs.**
- **This condition is called ERYTHROBLASTOSIS FETALIS.**



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