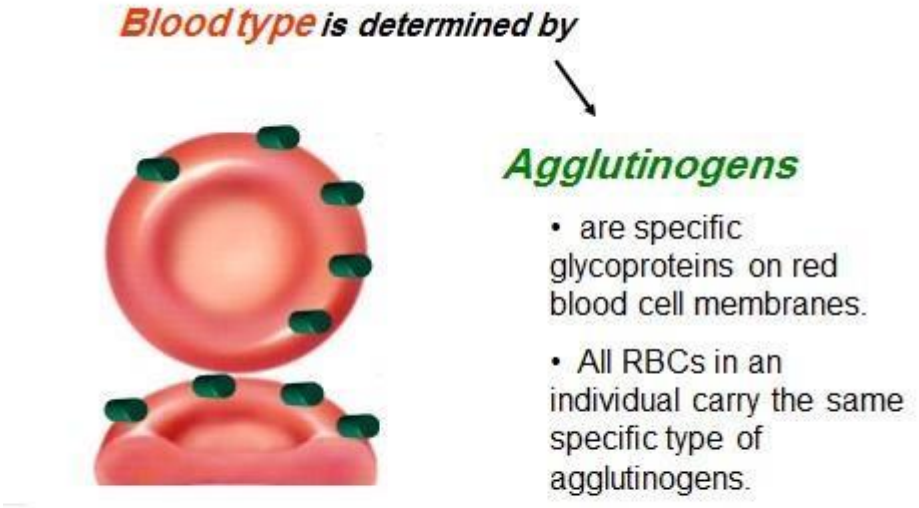
Blood Groups

The ABO blood group consists of blood types A, B, AB and O, depending on the presence or absence of two antigens – type A and type B- occur on the surface of the R.B.C. it is also called (agglutinogens) because they often cause blood cell (agglutination) that cause blood transfusion. Because of the way these agglutinogens are inherited, people may have neither of them on their cells, they may have one, or they may have both simultaneously.

Type A: RBCs carry agglutinogen A.
Type B: RBCs carry agglutinogen B.
Type O: RBCs carry no A nor B agglutinogens. Type AB: RBCs carry both A and B agglutinogens



Many genes have more than two alleles in a population. The ABO groups afford multiple alleles. Phenotypically, a person may have blood type A,B,AB and O owing to presence of three alleles in the population. Two of alleles are dominant and symbolized with a capital (I) (for immunoglobulin) and a superscript: I and I . there is one recessive allele, symbolized with a lower case i.

Genotype	Phenotype
I I	A
I i	A
I I	B
I i	B
I I	AB
i i	O

The essential function of DNA is to serve as a code for the structure of protein synthesized by a cell. A gene is a sequence of DNA nucleotides that code for a protein.

Agglutinins react against any AB agglutinogen expect those present on a person's own R.B.C. the agglutinin that reacts against antigen A is called α agglutinin, or anti-A, it is present in the plasma of people with type O or type B bloodthat is , any one who does not possess agglutinogen A . the agglutinin that reacts against antigen B is β agglutinin, or anti-B, and is present in type O and A individuals – those who don't possess agglutinogen B. Each agglutinin molecule has 10

binding sites where it can attach to an A or B agglutinogen. An agglutinin can therefore attach to several R.B.C. s at once and bind them together.

Agglutination

Is the process in which R.B.C. s adhere to each other in masses that are bound by these agglutinins.

Agglutinins

The agglutinins are gamma globulins, as other antibodies, and they are produced by the same cells that produce antibodies to any other antigens. Most of them are IgM and IgG immunoglobulin molecules. But why are these agglutinins produced in people who do not have the respective agglutinogens in their R.B.C.s? however, small amount of group A and B antigens enter the body in the food, in bacteria, and in other ways and these substances initiate the development of the anti-A or anti-B agglutinins.

Blood types	***Agglutinogens***	***Agglutinins***
A	**A**	**Anti B**
B	**B**	**Anti A**
AB	**A and B**	**——**
O	**——**	**Anti A and Anti B**

A person's ABO blood type can be determined by placing one drop of blood in a pool of anti-A serum and

another drop in a pool of anti-B serum. Blood type AB will exhibit conspicuous agglutination in both antisera; type A or B will agglutinate only in the corresponding antiserum; and type O will not agglutinate in.

Anti-A	**Anti-B**	**Percentage %**
Type A +	**–**	**41%**
Type B –	**+**	**9%**
Type AB +	**+**	**3% Type**
O –	**–**	**47%**

In giving transfusion, it is imperative that the donor's blood not agglutinate as it inters the recipient's blood stream. For example, if type B blood were transfused into type A recipient, the recipient's anti-B agglutinins would immediately agglutinate the donor's R.B.C.s. a mismatched transfusion causes a *Transfusion Reaction*. The agglutinated R.B.C.s block small blood vessels, hemolyze, and release their Hb over the next few hours to days. Free Hb can block the kidney tubules and cause death within a week or so from acute renal failure. For this reason, a person with type A (anti-B) blood must never be given a transfusion of type B or AB blood.

Type (AB) called the *Universal Recipient* while (O) *Universal Donor*.

The Rh Group

Along with the O-A-B blood group system, the Rh system is important in the transfusion of blood. In the O-AB,

the agglutinins responsible for causing transfusion reaction develop spontaneously, where as in the Rh system, spontaneous agglutinins almost never occur. There are 6 types of Rh antigens, each of which is called an Rh factor. These types are C,D,E,c,d and e .A person who has a C antigen doesn't have c, but person missing the C antigen always has the c antigen. The same for D-d and E-e antigens. The type D is widely prevalent in the population. Therefore, anyone who has this type is said to be Rh+, where as a person who does not have type D is said to be Rh– .About 85% of people are Rh+ and 15% are Rh– .

Formation of Anti-Rh agglutinins:

When R.B.C.s containing Rh factor or even protein breakdown products of such cells are injected into a person whose blood does not contain the factor- that is, into the Rh – person anti-Rh agglutinins develop slowly and maximum concentration of agglutinins occurring about 2-4 months. On multiple exposure to Rh factor, the Rh – person become strongly (*sensitized*) to Rh factor.

Erythrobastosis Fetalis (Hemolytic disease of Newborn)

This disease of the fetus is characterized by agglutination and phagocytosis of R.B.C.s . In most instances of this diseases, the mother is Rh – and father is Rh+. The baby has inherited the Rh+ antigen from father, and mother has developed anti-Rh agglutinins from exposure to the

baby's Rh antigen , in turn, the mother agglutinins diffuse through the placenta into the fetus to cause R.B.C.s agglutination.

Effect of the Mother's Antibodies on the Fetus:

After anti-Rh antibodies have formed in the mother, they diffuse slowly through the placental membrane into the fetus's blood. There they cause agglutination of fetus's blood. The agglutinated R.B.C.s subsequently hemolyze, releasing Hb into the blood. The macrophages then convert the Hb into *Bilirubin*, which causes the skin to yellow (Jaundice). The antibodies can also attack and damage other cells of the body. The jaundiced erythroblastotic neonate is usually anemic at birth, and anti-Rh agglutinins from mother usually circulate in the infant's blood for 1-2 months after birth, destroying more and more R.B.C.s.

The usual treatment is to replace the neonate's blood with Rh – blood. About 400 milliliters of Rh – blood is infused over a period of 1.5 or more hours while the neonates own Rh+ blood is being removed. The Rh – cells are replaced with the baby own Rh+ cells.

Transfusion Reactions resulting from mismatched Blood Types

If donor's blood of one blood type is transfused to a recipient of another blood type, a transfusion reaction is likely in which the R.B.C.s of donor blood are agglutinated. It is rare that the transfused blood causes agglutination of the recipient's cells, the plasma portion of the donor's blood immediately becomes dilated by all the plasma of recipient, there by decreasing the titir of infused agglutinins to a level low to cause agglutination. On other hand, the infused blood does not dilute the agglutinins in the recipient's plasma to major extent. Therefore, the recipient's agglutinins can still agglutinate the donor's cells.



Nature of Antibodies

The antibodies are gamma globulins called immunoglobulin and they have molecular weights between 160,000-970,000. they always constitute about 20% of all the plasma protein.

It is composed of combinations of light and heavy polypeptide chains, most of combination are 2 light and 2 heavy chains.

This structure of the typical IgG, showing 2 heavy polypeptide chains and 2 light polypeptide chains. The antigen binds as two different sites on the variable portion of the chains. The end of each light and heavy called variable portion, the remainder of each chain is called constant portion.
Each antibody is specific for a particular antigen, this caused by the structural organization of amino acids in variable portion of both light and heavy.

There are many bonding sites that antibody-antigen coupling is nevertheless exceedingly strong, held together by:

1. **Hydrophobic bonding.**
2. **Hydrogen bonding.**
3. **Ionic attractions.**
4. **Van der walls forces.**

There are five general classes of antibodies, respectively IgM, IgG, IgA, IgD and IgE. The antibodies have 10 binding sites that make them exceedingly effective in protecting the body against invaders.

The antibodies acts mainly in two ways to protect the body invading agents by:

1. **direct attack on the invader and.**
2. **by activation of complement system.**

In the direct attack, the antibody like Y-shaped bars, reacting with antigens, because of bivalent nature of the antibodies and multiple antigen sites on most invading agents, the antibodies can inactivate the invading agents in several ways:

1. **Agglutination, in which multiple large particles with antigen on their surface.**
2. **Precipitation, in which the molecular complex of soluble antigen and antibody becomes so large that it is rendered insoluble and precipitates.**
3. **Neutralization, in which the antibodies cover the toxic sites of the antigenic agent.**
4. **Lysis, in which some potent antibodies are occasionally capable of directly attacking membranes of cellular agents and there by causing rupture of the cell.**

The Activation of Complement: **complement is a collective term describes a system of about 20 proteins, many of which are enzyme precursors.**