Chapter 4
Immunity and Blood Groups

Every day Human body encounters many pathogens, but it does not suffer from diseases very easily. Main reason for this is the presence of pathogen eradicating **resistance power (immunity)** in the body. Immunity could be innate or acquired. The study of all the reactions and related systems that work for the eradication of the pathogen from the body is called Immunology. A large number of cells, lymphatic or immunological organs (like Bone Marrow, Lymph nodes, Thymus, Liver etc.), Blood and Lymph are functional in this system. Two types of immunity works in the body-

A. Innate defense mechanism (innate immunity):

This is an inborn immune system which is also known as nonspecific or natural immunity. It is named as nonspecific because this defense mechanism does not provide specific immunity against a specific pathogen rather it employs a common mechanism against all the antigens. The following factors work for the innate immunity-

(1) Physical Barriers- like skin, cilia and flagella found on nasal cavity and other organs and mucous etc.

(2) Chemical Barriers-like acid found in the stomach, acidic environment of stomach and vagina, chemicals found on the skin, chemicals found in various body secretions like saliva, tears, sweat etc.

(3) Cellular Barriers- cells like Macrophage, Monocytes and Neutrophils which are active in phagocytic activities. Besides, cytotoxic cells like Natural Killer cells also works as cellular barriers.

(4) Fever, Inflammation etc.

B. Acquired defense mechanism (Adaptive immunity): This is also called as Adaptive or Specific immunity. In this type of immunity, the host specifically attacks on specific invader microorganisms or foreign objects. Antibodies are synthesized in this immunity. Antibodies so produced react specifically with the antigens. These reactions stimulate the Cell Mediated Immunity. As a result of all these, antigen is eliminated from the body. Specific immunity is of two types:

(1) Active Immunity-Immunity in which body itself synthesizes antibodies against antigen. This immunity works for that particular antigen against which antibodies are synthesized.

(2) Passive Immunity-Immunity in which specific external antibodies against a particular antigen are introduced in the body. In this immunity, antibodies are not produced by the body.For example - vaccines of Diphtheria and Tetanus.

4.1 Antigen and Antibody

Antigens (Ag) are those outer pathogen or substance which after entering in the body activates the B lymphocytic cell to differentiate in antibody secreting plasma cells. Antigens induce them to produce antibodies and specifically react with these antibodies.

Antibodies (Ab) are the proteins which are produced as a result of interaction of antigens with the B cells present in the body and can specifically get coupled with that particular antigen. This pairing is a fundamental requirement for the success of immune system and depends upon the structural uniqueness of the Antigen.

4.1.1 Antigen

Normally they are foreign pathogens or substances which have a molecular weight of 6000 Daltons or more. They can be of various chemical groups like proteins, polysaccharides, lipids or nucleic acids. Sometimes few body substances and body cells (like virus infected or cancerous cells) can also act as antigens. After entering inside the body, an Antigen first encounters the innate immune system. Afterwards this Antigen

activates the specific defense system.

Antigens couples with the specific antibodies and forms Antigen- Antibody complexes. Most chemicals other than proteins can interact with the antibodies but they are not very active in the antibody production.

The whole molecule of Antigen does not interact with the Antibody rather only a specific part of it can join with the Antibody molecule. This part of Antigen is called as **Antigenic Determinant or Epitope**. In proteins, a chain of 6-8 amino acids acts as Antigenic determinant. A protein can have many Antigenic determinants. The total number of epitope is called as **Valence of the Antigen**. Valence of most bacterial antigens is 100 or more.

The destruction of antigen by specific immunity is carried out in four steps.

1. Differentiation between self and foreign Antigen.
2. Plasma cell formation by the activated B cells. They are produced on the basis of the epitope(s) present on the foreign antigen.
3. Synthesis of specific Antibodies by the Plasma cells.
4. Destruction of the Antigen by Antigen (Ag) - Antibody (Ab) reactions and Cell Mediated Immunity.

4.1.2 Antibody

Antibodies are also called as Immunoglobulin's (Ig). They are Gamma Globulin (γ globulin) proteins which are synthesized by the Plasma cells and are found in the blood and other body fluids. Antibodies identify and interact with the antigen to make it ineffective. The portion of the antibody which interacts with the Antigen is called **Paratope**.

4.1.2.1 Structure of Antibody

Antibody has a shape similar to the Y alphabet of English. It is composed of four structural units. There are two heavy and large [H] and two light and small [L] polypeptide chains. One heavy and one light chain together forms HL dimer. Two such [HL] dimers together forms an Antibody. In other words an Antibody molecule is made up of two homogeneous halves. Both these halves are joined with each other through disulfide bonds. Each of the half is made up of one H and one L polypeptide chain. The H and L chain found in each of the halves are also joined with disulfide bonds. Each heavy chain is made up of 440 amino acids while each L chain is made up of 220 amino acids. The heavy chain is attached with a carbohydrate moiety. Each heavy and light chain can be divided into two parts - **(a)Variable Portion:** This portion reacts with the Antigen and is found onthe NH_2 end of the chain. This portion is also called Fab portion. **(b) Constant Portion:** This portion is situated at the COOH end of the chain and is also called as F_c portion. The point of origin of the Y structure of most of the Antibodies is flexible and is known as **Hinge region** (Figure 4.1). Being flexible this region permits the variable portion of the Antibody to adjust according to the size of the antigen and react with it.

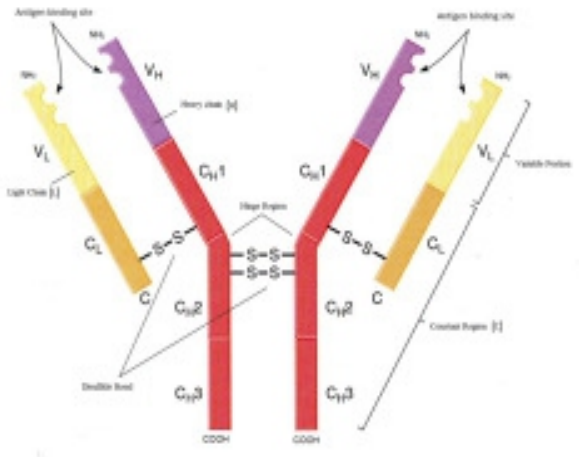

Figure 4.1: Structure of Antibody

4.1.2.2 Types of Antibodies

Five different types of heavy polypeptide chains are found among the Antibodies. They are denoted by Greek letters α (Alpha), γ (Gamma), (Delta), ε (Epsilon) and μ (mu). On the basis of the presence of heavy chain present, Antibodies can be divided into five types (Table 4.1). IgA has a dimeric structure while IgM has a pentameric structure. All the other antibodies

are monomeric. The main antibody of the body is IgG and is present in blood and other body fluids. IgG is the only antibody that can cross the placenta and reach to the embryo. Among all the antibodies found in the serum IgG has the highest concentration. IgM is the first Antibody which is produced in response to an Antigen.IgG is produced after the production of IgM. IgA is the only Antibody found in Mothers' milk. This Antibody is vital for the immunity of the new born baby. IgE Antibody primarily works on Basophil and Mast cells and participates in Allergic reactions.

S.No.	Type of Antibody	Present Heavy Polypeptide Chain
1.	IgG	γ (Gamma)
2.	IgM	μ (Mu)
3.	IgA	α (Alpha)
4.	IgE	ε (Epsilon)
5.	IgD	δ (Delta)

4.2 Blood and blood groups

Blood is a fluidic living tissue which is thick, sticky and red coloured and flows into the blood vessels. This is made up of Plasma (nonliving liquid medium) and Blood Corpuscles (living cells). Plasma functions to transports the nutrients absorbed by the intestine to various body organs and carry the harmful substances from different organs to the excretory organs. Three different types of blood corpuscles are found in the blood.

(1) Red Blood Corpuscles- Transports and exchange gases

(2) White Blood Corpuscles- Protects the body from pathogens

(3) Platelets - Protects the blood vessels and helps to prevent bleeding.

4.2.1 Blood Groups

Firstly, Karl Landsteiner, an Australian Scientist in 1901 classified the blood into different blood groups. On the basis of presence or absence of various Antigens on the surface of Red Blood Corpuscles, blood has been classified into various groups. Normally these Antigens can be proteins, glycoproteins, carbohydrates or glycolipids. These Antigens are synthesized from single allele or related gene which is inherited from both mother and father.

Two types of Antigens (Antigen 'A' and Antigen

Table 4.2 Various Blood Groups (ABO and Rh grouping)

S.No.	Blood Group	ABO Blood grouping		Rh Grouping	Antibody found in the Blood
		Antigens present on the surface of the RBC	Genotype of the Antigen	Rh Antigen present on the surface of the RBC	
1.	A^+	A	I^AI^A or I^Ai	Present	Anti B
2.	A^-	A	I^AI^A or I^Ai	Absent	Anti B
3.	B^+	B	I^BI^B or I^Bi	Present	Anti A
4.	B^-	B	I^BI^B or I^Bi	Absent	Anti A
5.	AB^+	A and B	I^AI^B	Present	Anti A and Anti B both absent
6.	AB^-	A and B	I^AI^B	Absent	Anti A and Anti B both absent
7.	O^+	None A and B	ii	Present	Anti A and Anti B both present
8.	O^-	None A and B	ii	Absent	Anti A and Anti B both present

'B') are found on the surface of the Red Blood Corpuscles. Based upon the presence of these two Antigens, four blood groups are found - A, B, AB, and O (Table 4.2). This classification is called **A B O blood grouping**. 'A' type blood has 'A' antigen on the surface of Red Blood Corpuscles while 'B' type blood has 'B' antigen on the surface of Red Blood Corpuscles. AB type blood has both 'A' and 'B' Antigens on the surface of Red Blood Corpuscles.Red Blood Corpuscles of 'O' type blood is devoid of both 'A' and 'B' Antigens (Table 4.2).

Apart from 'A' and 'B' Antigens, another Antigen named Rh can also be found on the surface of the Red Blood Corpuscles. If Rh antigen is present on the surface of the Red Blood Corpuscles, blood is called **Rh positive (Rh+)**. The blood in which Red Blood Corpuscles are devoid of Rh Antigen is called **Rh negative (Rh-)** (Table 4.2).This classification system is called as **Rh Grouping**.

Persons having 'A' type blood group have IgM type Anti B antibody in their body. In the same way Anti A Antibody is found in persons having type B blood and Anti A and Anti B antibodies in the blood of the persons with O blood group. The persons with AB blood group have neitherAnti AnorAnti B antibodies (Table 4.2). If a person with 'A' blood group is transfused with Type B blood, Anti B antibodies present in his blood will destroy the B type Red Blood Corpuscles. This is the case with every mismatch blood transfusion. Hence, before blood transfusion it should always be taken into consideration that the blood group of the donor and the recipient belongs to the same group. A person with 'O' type blood group is called **Universal Donor** while a person with 'AB' blood group is called **Universal recipient**. This means that a person with 'O' type blood can donate blood to all and person with 'AB' type of blood can accept blood from all.

4.3 Rh Factor

Rh (Rhesus) factor is a protein of about 417 amino acids. It was discovered in a spices of monkey named Macaca rhesus (*Macaca mullatta*). This protein is also found on the surface of the human Red Blood Corpuscles. About 85% of the human population in the world is Rh+ while the rest 15 % is Rh-.

Five different types of Rh factors - **Rh.D, Rh.E, Rh.e, Rh.C and Rh.c** are found in humans. The frequency of these Rh factors in human population is as follows: Rh.D (85%), Rh.E (30%), Rh.e (78%), Rh.C(80%) and Rh.c (80%). Among all the Rh factors, Rh. D is most important and predominantly immunogenic.

Not only the blood group but matching of the Rh factor is important for blood donation. Transfer of blood from Rh+ person to a Rh- person results in the development of IgG antibodies against in the reciepient. The IgG antibodies so produced works against the Rh factors. These antibodies destroy the Red Blood Corpuscles possessing the Rh factor by the process of **Agglutination**. Accumulation of large amount of harmful compound called **Bilirubin** in the blood. The excess amount of bilirubin cause impairment of liver and spleen functioning. This may lead to the failure of the kidney and can ultimately result in the death of the person. Here, this is to be noted that the Anti Rh Antibodies are not pre-synthesized rather they are produced after the first contact of Rh negative blood with Rh positive blood.

If during the pregnancy, mother is Rh negative and the foetus is Rh positive, special attention is required at the time of childbirth. During the first delivery, blood of the mother and the foetus mixes with each other. This leads to the production of Rh Antibodies in the mother. The first baby is born normal. The complicacy may arise during the second pregnancy, if this time too fetus is Rh negative. Through placenta, Rh Antibodies present in mother's blood mixes with the circulating foetal blood. Here they reacts with the Rh proteins present on the surface of the foetal

Red blood cells. These Antibodies destroys the Red blood corpuscles through Agglutination and leads to hemagglutination. This may even lead to the death of the foetus in the mother's womb. Even if the infant survives, he becomes very weak and generally suffers from hepatitis. This disease is called as **Erythroblastosis fetalis** (Figure 4.2). For the treatment of this disease, mother is vaccinated with anti IgG Antibodies (anti Rh.D) within 24 hours of the first delivery. These are called **RhogamAntibodies**. By destroying the fetal Rh positive blood cells present in themother's blood, these Antibodies inhibit the production of Anti Rh Antibodies in the mother. Many times,for the treatment of this disease, foetal blood is replaced by the process of transfusion.

Many times Rh incompatibility is the main cause of hemolysis due to blood transfusion.

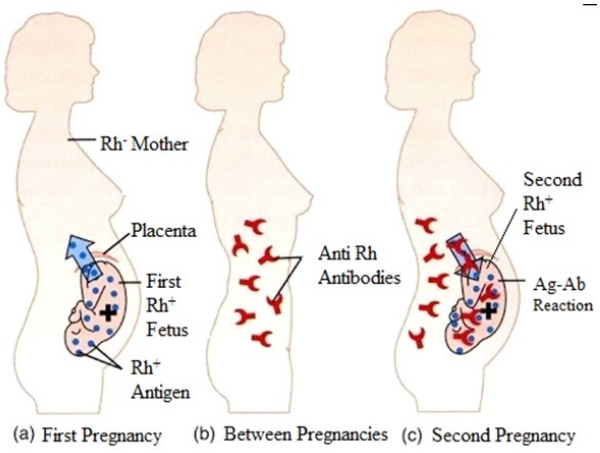

Figure 4.2: Erythroblastosis foetalis

4.4 Blood transfusion

This is a method in which blood or blood products like platelets, plasma, etc are transferred from the circulatory system of one person to another. Dr. Jean-Baptiste Denys, a French physician on 15 June 1667 carried out blood transfusion for the first time. He transfused blood in a 15-year old boy from a sheep. Although ten years later blood transfusion from animals to humans was prohibited.

4.4.1 Requirement for Blood transformation

Blood transfusion is absolutely necessary in the flowing situations-

1. At the time of injury or excessive bleeding
2. Serious blood deficiency
3. During Surgery
4. In the condition of deficiency of platelets in the blood
5. Patients of Hemophilia
6. Patients of Sickle Cell Anemia.

4.4.2 Process of Blood Transfusion

Blood Transfusion is a scientific process which is accomplished as follows-

(A) Blood Collection

(1) Before the process of blood collection, donor is examined medically.

(2) After medical examination, blood from the donor is collected in special sterilized pouches containing anticoagulants. Cannula of suitable capacity is used for blood collection.

(3) The collected blood is kept in a refrigerator. This prevents the bacterial growth and down regulates the cellular metabolism in the blood.

(4) The stored blood is subjected to different tests like Blood group, Rh factor, Hepatitis B, Hepatitis C, HIV etc.

(5) After blood collection, the donor is kept under medical surveillance for some time so that the treatment of any repercussion,if arises due to blood donation,could be treated. (Normally no unusual reaction takes place in the body after blood donation). In humans, plasma is replenished in 2-3 days after the blood donation while after 36 days, blood cells are restored in the blood circulation.

(B) Transfusion

(1) Prior to transfusion, the patient's blood is matched with the blood of the donor (ABO, Rh etc). Transfusion can only be carried out after this process.

(2) The collected blood is brought out of the storage area just 30 minutes before the start of the transfusion process.

(3) Blood is transfused only through intravenous mode. This is a four hour long procedure which is mediated by the help of a cannula.

(4) Medicines are given by the doctor to prevent the transfusion related reactions like fever, chill, pain, cyanosis, irregularity of the heart beat and others.

On the basis of source of blood, transfusion can be of two types-

(1) Allogenic transfusion - Such a Transfusion in which blood collected from other persons is used.

(2) Autogenic transfusion - Such a Transfusion in which blood collected from the person itself is used.

After processing the donated blood can also be segregated into various components like Red Blood Cells, Plasma and Platelets. These components are then stored in refrigerated conditions. In addition to humans, blood transfusion can be carried out in animals also.

4.4.3 Precautions to be taken during Blood Transfusion

1. Matching ABO Antigen in the blood of the patient and the donor.
2. Testing donor's blood for the absence of any pathogen or harmful substance.
3. Matching the Rh factor (especially Rh.D.) in the blood of the donor and the patient.
4. Storage of the collected blood in refrigerated conditions (after completing the desired processes).
5. In every circumstance, protecting the collected blood from contamination.
6. Blood collection and transfusion must essentially be carried out in the presence of a physician.

The following diseases or infections can occur due to the carelessness observed during the transfusion (i) Infection of HIV-1 and HIV-2 (HIV-Human Immuno deficiency Virus) (ii) Infection of HTLV 1 and HTLV-2 (HTLV - Human T-Lymphotropic Virus) (iii) Hepatitis -B and Hepatitis C infection. (iv) Creutzfeldt-Jacob disease etc.

4.5 Significance of blood group heredity

Many different blood types are found in humans. They are addressed as ABO blood group system. The control of expression of the blood group depends on the coordination of three alleles. All these allelesare part of the same gene and are represented by IA, IB and I^O or *i*. The Antigen A and Antigen B found on the surface of the Red Blood Corpuscles are produced by allele I^A and I^B respectively. The I^O and *i* alleles are recessive and are not involved in the production of any blood Antigen.

The expression of blood group in a person is dependent on the interaction between any two alleles. Based on the presence of type of alleles, six gene formats of the blood are found in humans (Table 4.3). O -Blood group is a result of homozygous recessive gene interaction. These genes show Mendelain inheritance.

Table 4.3 Genotype of Blood Groups

S.No.	Blood type	Genotype
1.	A	$I^A I^A$
		I^A i
2.	B	$I^B I^B$
		I^B i
3.	AB	$I^A I^B$
4.	O	i i

There are many applications of Blood Group inheritance. It is mostly used to &solve the paternal disputes, in carrying out successful blood transfusions, in the treatment of neonatal blood hemolysis and hereditary disorders like hemophilia etc. The use of blood group inheritance in the solution of paternity related disputes can be understood through the following example :- let's assume that two couple are claiming for a child whose blood group is B. The male of one of the couple has O (*ii*) blood group and the female has AB (I^AI^B) blood group. The male in second couple has A (I^AI^A) and female has B (I^A i) blood group.

In these conditions, as per the Mendels' law of inheritance, the child can have the flowing possible blood groups (Figure 4.3).

It is clear from the figure 4.3 that it is the couple one who could produce a baby of B blood group and they are the actual parents of this child.

In the similar way knowledge of genetic inheritance is very important for successful blood transfusion and the treatment of the hereditary diseases.

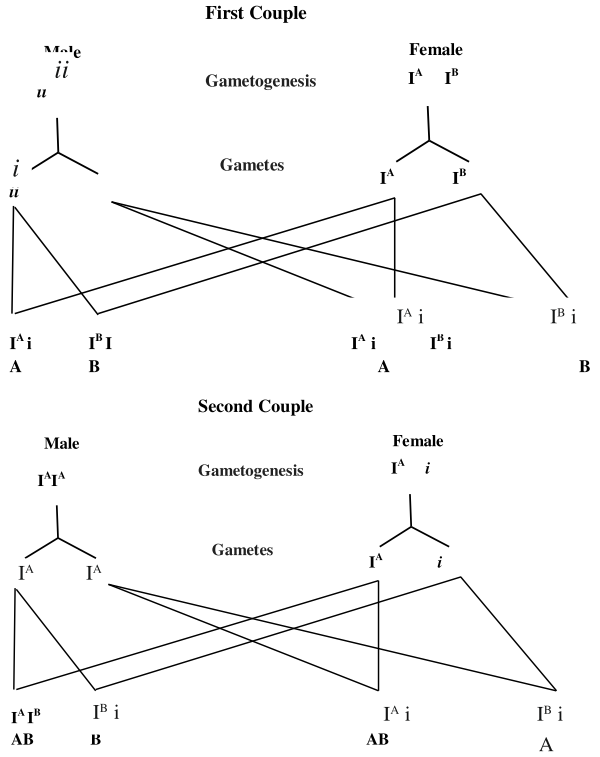

Figure 4.3 Determination of Paternity by Blood group inheritance

4.6 Organ donation and body donation

Donation of a tissue or an organ to another person by a living or dead person is called **Organ Donation**. The organ donated by the donor is implanted in the recipient's body. In this way the life of the recipient can, not only be saved, but he can enjoy a happy life too. Organ donations are generally carried out only after the donor's death. About 50 needy people can be helped from an inanimate body. Hence body donation is very important for organ donation. A child to ninety years old veteran can donate their organs and body.

4.6.1 Importance of organ and body donation

The human body is the masterpiece of nature and in no case it can remain permanent. It is said in the Indian philosophy that the human body is made of - air, water, soil, fire and sky and after death it gets fused in these elements only. Now the question arises that whether there exists any process that can keep our body alive for a long time? It has also been said that "A dead animal fulfills hundreds of human work, but dead human is no use for any one" (*PASHU MARE MANUJ KE SOO KAAM SANWARE, MANUJ MARE KISI KE KAAM NAN AAVE*). Hence, it has become the need of the time that even after death;humans can be used for the welfare of living beings. This can be possible when after death we could remain alive in others. After our death, donation of our eyes, kidneys, liver and other organs could bring happiness in the life of a needy person. This type of donation is categorized as Pure Donation. The donation of this category is considered as the best and most holy charity in our Indian philosophy. From the eternal ages, organ donation and body donation were considered as the work of great virtue by our spiritual teachers. In ancient times, saint Dadhichi donated his bones for the benefit of the society.

There is a need to donate nearly two lakh kidneys every year in India, while availability is only 7000 to 8000 per year. Similarly, every year around 50,000 people live in the hope of heart transplantation but availability of heart in India is only 10 to 15. In India, about 50,000 livers are required every year for transplantation, in India, but only 700 people gets this opportunity. More or less the same condition persists with all the other organs. According to an estimate, every year about five lakh people in India die due to the organ failure and lack of organs for transplantation.

Like organ donation, body donation is such a charity which is absolutely essential for the society. Organ donation is essential for two major reasons: (a) The organs can be obtained from the dead body and

transplanted to the needy. Often, the organ donation is carried out from a brain of dead person. In such cases, the brain of the concerned person ceases to function, but other parts of the body remains functional. Organs like heart, liver, kidney and others can be obtained from these dead persons and can be implanted in the needy individuals. However, statistics show that only one person out of a thousand dies in such a way (brain dead). Within six to eight hours of death, the body can be used for eye donation. (b) To become a best doctor, the medical students need to get training on the dead bodies. Only after the training cum experimental work on dead bodies, medical students can better understand the human body. Thus, organ donation by human beings has become very important these days. It is the ultimate utility of the human body. The donors of such a body can become free from their family relations and socio-religious bondages. They act as inscription for the society.

It is a matter of great disappointment that due to ancient conservative beliefs, the number of organ donors in India is 0.8 per ten lakhs individuals, whereas in developed countries it is 10 to 30. In such a situation, we must realize and understand the importance of organ donation and body donation and help those whose life is very annoying in the absence of some organ. We should come forward for this noble cause and motivate society for this virtuous human work. We should seek help from saints, teachers, intellectuals and others prominent persons of the society to overcome the superstitions prevailing in the society and to educate people for this sacred task with an ultimate aim of providing benefit to the needy people. For this purpose, the Government of India, every year, celebrates August 13 as the Organ donation day.

Many eminent persons of the society have came forward for this noble act. Captain Lakshmi Sehgal (who was involved in the freedom fight with Netaji Subhash Chand Bose) donated cornea at the age of ninety years and filled light in the life of two people. Recently, as per his wish, the family members of the famous author Dr. Vishnu Prabhakar donated his body after his death. The bodies of the former Chief Minister of West Bengal, Shri Jyoti Basu, the renowned social worker Shri Nana Deshmukh and some other eminent persons were also donated after their death as per their wish. Sadhvi Ritambhara and cricketer Gautam Gambhir have also announced to donate their bodies after death. Such persons are real saints in true sense and are flag bearers of this revolutionary idea.

All of us should realize our duty to donate blood, organs and body after death, so that by this sanctified work our needy brothers and sisters can live a comfortable and graceful life.

4.6.2 Who can do Organ and Body donation

Any person regardless of religion, race or gender can donate his organ and body. Persons less than 18 years of age essentially require the consent of their parents or legal guardians. The donor should provide written consent in the presence of two witnesses during his lifetime.

If it has not been done before death, then the right of organ and body donation lies with the person who has the legitimate authority of the body. Organ and body donation in India is legally valid.

Important Points

1. There are two types of immune system in the body - Natural and Acquired.
2. Antigen is an external pathogen that induces antibody production.
3. Antibody is a specific gamma globulin protein that can combine with antigens. They are formed by plasma cells.
4. Antibodies have two heavy and two light glycoprotein chains.
5. Antibodies are of five types -IgA, IgD, IgE, IgG and IgM.
6. Three types of corpuscles-Red blood corpuscles, white blood corpuscles and platelet are found in the blood.

7. On the basis of antigens found on the surface of the red blood cells, human blood is divided into A, B, AB and O types.
8. Person with AB+ blood group can accept blood from all, while person with O+ blood group can donate blood to all.
9. On the basis of the presence or absence of Rh factor on red blood cells, blood is of two types: Rh positive and Rh negative.
10. Five types of Rh factors are found in humans. Rh.D. is most prominent among them.
11. Blood transfusion is a process by which blood or blood based products like plasma, platelet etc. are transferred from the circulatory system of one person to the circulatory system of other.
12. The donated blood after rigorous processing can be separated into different components like red blood cells, plasma, platelet etc.
13. The control of the Blood group depends upon themutual interaction of the three alleles (I^A, I^B and I^A or *i*).
14. In humans, on the basis of the presence of alleles, blood is of the following types -A, B, AB and O.
15. There are many applications of Blood group heredity such as - Solution of paternal disputes, carrying out successful blood transfusions, the treatment of neonatal blood hemolysis and treatment of hereditary disorders like hemophilia etc.
16. The donation of a tissue or organ by any living or dead person to someone in need is called organ donation.
17. Donation of one's body for organ transplantation and medical training is called as body donation.
18. Organ and body donation is of absolute necessity and importance for the betterment of human society.
19. Every year, 13 August is celebrated as Organ donation day in India.
20. Organ and Body donation is legally valid in India.

Practice questions

Objective type questions

1. Cells used in the immune system are not found in ……..
   (a) Bone Marrow (b) Liver
   (c) Stomach (d) Lymph Nodes
2. The plasma cell is the transformed form of which of the following cells?
   (a) B Lymphocyte Cell (b) T Lymphocyte Cell
   (c) Neutrophil (d) Both (a) and (c)
3. Antigenic determinants are found in which of the following?
   (a) Antigen (b) IgG Antibody
   (c) IgM Antibody (d) Plasma cells
4. The first Antibody produced is?
   (a) IgG (b) IgM
   (c) IgD (d) IgE
5. Which antibody is found in mother's milk?
   (a) IgG (b) IgM
   (c) IgD (d) IgA
6. Which of the following cells is not found in the blood?
   (a) Red blood cells (b) White blood cells
   (c) B Lymphocytic cells (d) Epithelial cells
7. Who classified blood in different groups?
   (a) Louis Pasteur (b) Karl Landsteiner
   (c) Robert Koch (d) Edward Jenner
8. Universal donor blood group is
   (a) A (b) AB
   (c) O (d) B
9. Major reason for Erythroblastosis foetalisis
   (a) Blood Transfusion in children
   (b) Rh Incompatibility
   (c) ABO Incompatibility
   (d) Both (a) and (c)

10. Which of the following is used in Allogeneic Transfusion?
(a) The stored blood collected from the person himself
(b) The stored blood collected from some other person
(c) The stored blood collected from sheep
(d) Both (a) and (b)

11. Which of the diseases do not occur due to the carelessness observed during blood transfusion?
(a) Hepatitis B
(b) Malaria
(c) Blood Hemolysis
(d) Creutzfeldt-Jakob disease

12. Which of the following blood group results from homozygous recessive gene interaction?
(a) 'A' Blood Group (b) 'B' Blood Group
(c) 'O' Blood Group (d) 'AB' Blood Group

13. Which among the following is not an application of Blood Group inheritance?
(a) Treatment of Hemophilia
(b) Treatment of Malaria
(c) Treatment of Dengue
(d) Both (b) and (c)

14. Which day is celebrated as Organ Donation Day in India?
(a) 13th September (b) 13th August
(c) 13th May (d) 13th June

15. The number of organ donorsin India (per ten lakh) is
(a) 0.1 (b) 2.0
(c) 0.8 (d) 1.8

Very short type questions

16. How many different types of defense mechanisms are found in humans?
17. How many different types of Antibodies are found in Humans?
18. What should be the minimum molecular weight of an antigen?
19. Which type of proteins are Antibodies?
20. Which antibody can cross placenta to reach the embryo?
21. Write the name of the antibody found on the surface of the mast cell.
22. Which cells found in the blood are involved in gaseous exchanges?
23. Which scientist classified the Blood?
24. Which blood group is universal blood donor?
25. Which blood group contains both A and B antigens?
26. What is the percentage of Rh positive persons in the world?
27. Which Rh factor is most important?
28. Who was the first person to perform blood transfusion?
29. What do you mean by Allogeneic Transfusion?
30. Write down the name of the alleles which controls the blood groups.
31. When does Organ Donation Day celebrated in India?
32. Write the name of two persons who have recently donated their body.

Short type questions

33. Define antibodies.
34. What are antigenic determinant?
35. What is the function of Hinge in an Antibody?
36. What is blood?
37. Explain ABO blood grouping.
38. What is Rh factor? Explain its significance.
39. What is blood donation? Explain.
40. Write precautions to be observed during the blood donation.
41. Explain the need of Organ donation.
42. Explain the gene type's responsible for ABO lood groups.

Essay type questions

43. Explain structure of antibodies.
44. Explain Erythroblastosis fetalis.

45. How does the process of blood transfusion carried out?
46. What is organ donation? Explain its importance.
47. Explain the importance of blood group hereditary.

Answer key

1	(c)	2	(a)	3	(a)
4	(b)	5	(d)	6	(d)
7	(b)	8	(c)	9	(b)
10	(a)	11	(b)	12	(c)
13	(d)	14	(b)	15	(c)