The Science of Blood and Blood Donation

- Dr. (Mrs.) V. Sivagangailakshmi*

Abstract

Blood is composed of a yellowish fluid, called plasma, in which are suspended the millions of cells that constitute about 45 percent by volume of whole blood. The blood also carries many salts and organic substances in solution. Blood has four main parts which are the red blood cells, white blood cells, platelets, and the plasma. The A and B antigen molecules on the surface of red blood cells are produced by two different enzymes. Beyond the ABO blood type and the Rhesus (Rh) blood type, the International Blood Transfusion Society recognizes twenty-eight additional blood types with names like Duffy, Kidd, Diego and Lutheran. There is no substitute of human blood. The only people that can help people who have lost blood from tragic disasters such as car accidents, fires, diseases, etc. are donators.A large number of people in our society are on prescription medications but that does not always mean one cannot donate blood. If a person were on the following medications, they would never be allowed to donate their blood.

Keywords: Platelets, Plasma, Transfussion, Disasters, Medication, Oxygenate, Capillaries, Erythrocytes

Introduction

Blood is a fluid substance that circulates in the arteries and veins of the body. Blood is bright red or scarlet when it has been oxygenated in the lungs and passes into the arteries; it becomes bluish red when it has given up its oxygen to nourish the tissues of the body and is returning to the lungs through the veins and the tiny vessels called capillaries. In the lungs, the blood gives up the carbon dioxide wastes it has taken from the tissues, receives a new supply of oxygen, and begins a new cycle. This movement of blood is brought about by the coordinate activity of the heart, lungs, and blood vessels.

Main Components of Blood

Blood is composed of a yellowish fluid, called plasma, in which are suspended the millions of cells that constitute about 45 percent by volume of whole blood. It has a characteristic odor and a specific gravity between 1.056 and 1.066. In an average healthy adult, the volume of blood is one-eleventh of the body weight, or between 4.5 and 6 liters (5 and 6 qt).

A great portion of the plasma is composed of water, a medium that facilitates the circulation of the many indispensable factors of which blood is composed. A cubic millimeter of human blood contains about 5 million red corpuscles called erythrocytes; 5000 to 10,000 white corpuscles called leukocytes; and 200,000 to 300,000 platelets called thrombocytes. The blood is a body tissue and is liquid in form. It consists of cells floating in the liquid medium. Blood cells are called corpuscles and liquid medium is blood plasma.

Plasma

It is a complex fluid and it is about 55% of the blood, plasma consists of 90% water. It also contains proteins (albumins, Cogens).

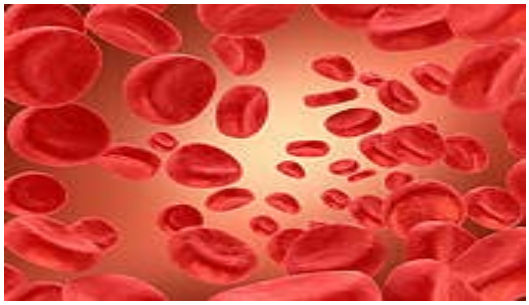
Corpuscles-The blood cells are of three types

Red blood cells (R.B.C.) or erythrocytes

The red blood cells are 5 million / cubic millimeter of blood in man. It is biconcave in structure. It is manufactured

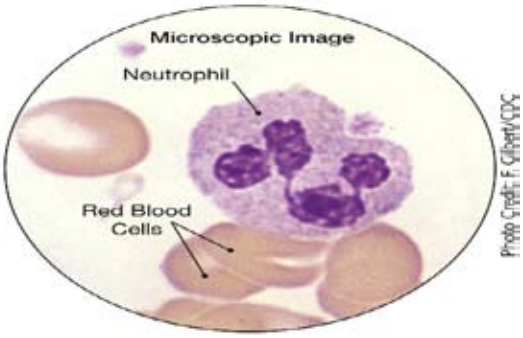
*M.D. Reader in Physiology, Rajah Muthiah Medical College, Annamalai University, Annamalainagar-608 002

in the Red Bone Marrow and has a life of 20-120 days. Their main constituent is a red pigment called haemoglobin. Haemoglobin is a protein with iron in its molecule; Haemoglobin transports oxygen and carbon dioxide and the blooc appears red due to its presence.



White blood cells (W.B.C.) or leucocytes

The white blood cells are large and consists of one nucleus each. The number of W.B.C. is 8000 in per cubic millimeter. The W.B.C. are manufactured in Red Bone Marrow and has life period of 24-30 hours. These cells destroy the harmful bacteria and dead cells. These cells are the defense forces of the body against infection and injury, i.e. to provide the immunity to the body.

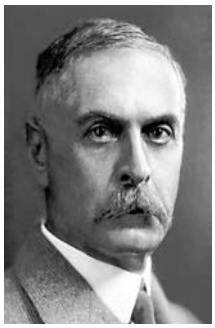


Blood platelets or thrombocytes

These are small spherical bodied cells with nucleus. These cells help in clotting of blood, preventing the excess loss of the valuable blood.

The blood also carries many salts and organic substances in solution. Blood has four main parts which are the red blood cells, white blood cells, platelets, and the plasma. White blood cells fight infection and kill off germs. Red blood cells deliver oxygen from the lungs to the rest of the body and transport carbon dioxide from the body to the lungs where it can be expelled. The red blood cells make up about half of bloods volume and it is the most abundant of the cells in the body; our body would die without them (fi.edu) Platelets along with other substances come together to form clots to stop bleeding. One must also have calcium and vitamin k present to support the formation of clots. If low on those nutrients it may take a longer time to stop bleeding when injured and without these nutrients you could bleed to death. Plasma is also a very important component of blood; it is the fluid portion of blood that enables the cellular components (red blood cells, white blood cells and platelets) to travel throughout the circulatory system (fi.edu). Antibodies travel to the battle fields of disease by way of the plasma.

Blood type, in medicine, classification of red blood cells by the presence of specific substances on their surface. Typing of red blood cells is a prerequisite for blood transfusion. In the early part of the 20th century, physicians discovered that blood transfusions often failed because the blood type of the recipient was not compatible with that of the donor. In 1901 the Austrian pathologist Karl Landsteiner classified blood types and discovered that they were transmitted by Mendelian heredity . June 14th is Karl Landsteiner's birthday. Landsteiner was an Austrian physician who developed the modern blood type classification system. He identified the agglutins on the surface of red blood cells and separated them by type. There are four basic blood types: A, B, AB, and O. Type A blood has an Anti-B antibody and Type A antigens. Type B blood has Anti-A antibodies and Type B antigens. Type AB blood has no antibodies and both Type A and B antigens. Type O blood contains both Anti-A and Anti-B antibodies and antigens.



Landsteiner later refined the system with Alexander S. Wiener by introducing the Rh factor to each blood type. Rh factors come in two flavors, Positive or Negative. Positive means the Rh antigens are present in the blood and Negative means they are not present. Blood typing greatly increases the chances of success in transfusions and organ transplantation. Medical practitioners can now identify if a person can donate blood or receive blood based on their blood types and Rh factors. This important work earned Landsteiner the 1930 Nobel Prize in Medicine.

The Genetic Character of Blood

Blood is a complex, living tissue that contains many cell types and proteins. A transporter, regulator, and defender, blood courses through the body carrying out many important functions.

Proteins & Blood Types

Distinct molecules called agglutinogens (a type of antigen) are attached to the surface of red blood cells. There are two different types of agglutinogens, type "A" and type "B". Each type has different properties. The ABO blood type classification system uses the presence or absence of these molecules to categorize blood into four types:

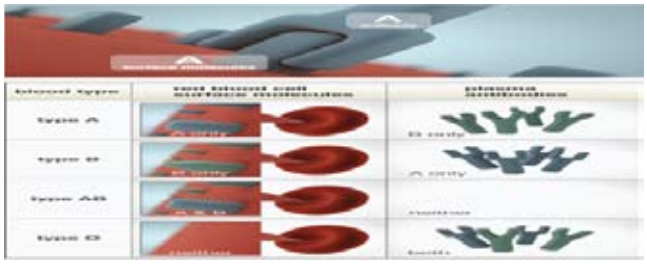
Another level of specificity is added to blood type by examining the presence or absence of the Rh protein. Each blood type is either positive "+" (has the Rh protein) or negative "-" (no Rh protein). For example, a person whose blood type is "A positive" (A +), has both type A and Rh proteins on the surface of their red blood cells.

Blood Type is Genetic

The A and B antigen molecules on the surface of red blood cells are produced by two different enzymes. These two enzymes are encoded by different versions, or alleles, of the same gene: A and B. The A and B alleles code for enzymes that produce the type A and B antigens respectively. A third version of this gene, the O allele, codes for a protein that is not functional and does not produce surface molecules. Two copies of the gene are inherited, one from each parent. The possible combinations of alleles produce blood types in the following way:

father \ mother	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

alleles	blood type
A+A =	A
A+O =	A
A+B =	AB
B+B =	B
B+O =	B
O+O =	O



When Blood Types Mix

Blood plasma is packed with proteins called antibodies. The body produces a wide variety of antibodies that will recognize and attack foreign molecules that may enter from the outside world. A person's plasma does not contain any antibodies that will bind to molecules that are part of his or her own body.

Blood Transfusion

When conducting a blood transfusion, it is important to carefully match the donor and recipient blood types. If the donor blood cells have surface molecules that are different from those of the recipient, antibodies in the recipient's blood recognize the donor blood as foreign. This triggers an immune response resulting in blood clotting. If the donor blood cells have surface molecules that are the same as those of the recipient, the recipient's body will not see them as foreign and will not mount an immune response.

There are two special blood types when it comes to blood transfusions. People with type O blood are universal donors because there are no molecules on the surface of the red blood cells that can trigger an immune response. People with type AB blood are universal recipients because they do not have any antibodies that will recognize type A or B surface molecules.Beyond the ABO blood type and the Rhesus (Rh) blood type, the International Blood Transfusion Society recognizes twenty-eight additional blood types with names like Duffy, Kidd, Diego and Lutheran. But Langereis and Junior have not been on this list. Although the antigens for the Junior and Langereis (or Lan) blood types were identified decades ago in pregnant women having difficulties carrying babies with incompatible blood types, the genetic basis of these antigens has been unknown until now. Therefore, "very few people learn if they are Langereis or Junior positive or negative," Ballif says.

"Transfusion support of individuals with an anti-Lan antibody is highly challenging," the research team wrote in *Nature Genetics,*"partly because of the scarcity of compatible blood donors but mainly because of the lack of reliable reagents for blood screening." And Junior-negative blood donors are extremely rare too. That may soon change. With the findings from this new research, health care professionals will now be able to more rapidly and confidently screen for these novel blood group proteins, Ballif wrote in a recent news article. "This will leave them better prepared to have blood ready when blood transfusions or other tissue donations are required," he notes. "Now that we know these proteins, it will become a routine test," he says.

A Better Match

This science may be especially important to organ transplant patients. "As we get better and better at transplants,

we do everything we can to make a good match," Ballif says. But sometimes a tissue or organ transplant, that looked like a good match, doesn't work -- and the donated tissue is rejected, which can lead to many problems or death. "We don't always know why there is rejection," Ballif says, "but it may have to do with these proteins." The rejection of donated tissue or blood is caused by the way the immune system distinguishes self from not-self. "If our own blood cells don't have these proteins, they're not familiar to our immune system," Ballif says, so the new blood doesn't "look like self" to the complex cellular defenses of the immune system. "They'll develop antibodies against it," Ballif says, and try to kill off the perceived invaders. In short, the body starts to attack itself. "Then you may be out of luck," says Ballif, who notes that in addition to certain Japanese populations, European Gypsies are also at higher risk for not carrying the Langereis and Junior blood type proteins. "There are people in the United States who have these challenges too," he says, "but it's more rare."

Other Proteins

Ballif and his international colleagues are not done with their search. "We're following up on more unknown blood types," he says. "There are probably on the order of 10 to 15 more of these unknown blood type systems -- where we know there is a problem but we don't know what the protein is that is causing the problem." Although these other blood systems are very rare, "if you're that one individual, and you need a transfusion," Ballif says, "there's nothing more important for you to know

BloodDisorders

There are many different blood disorders that can be very harmful to an individual's health. Some of the blood disorders are preventable and others we cannot prevent because they are hereditary. There are blood disorders that just cause discomfort and there are some that can be fatal. Blood disorders can affect any of the three main components of blood: red blood cells, white blood cells, platelets and can also affect the plasma (disease.com). The blood disorders that I will be covering in this paper are Iron Deficiency Anemia, Sickle Cell Anemia, and Thrombocytopenia. Treatment and prognosis for blood disorders vary, depending on the blood condition and the severity. Regardless of the type of blood disorder it is important to make sure that you get proper treatment.

Blood Donation

Every minute of every day, someone needs blood. That blood can only come from a volunteer donor, a person like oneself who makes the choice to donate. When one makes a blood donation, they are joining a very select group. There is no substitute of human blood. The only people that can help people who have lost blood from tragic disasters such as car accidents, fires, diseases, etc. are donators. A bleeding trauma victim can run through 100 units of blood in no time. Also, within one's lifetime 60% of the population will need to be given blood, yet less than 5% of the population donates. That number needs to be drastically increased in order to help our nation and save the lives of innocent people.

According to the Journal of American Medical Association, it is noted that just 1 pint of blood can save three lives. Giving blood does not just benefit recipients. Regardless of age, donating blood offers many benefits for donors. Then, it must be used relatively quickly or it will perish-whole blood for instance, according to the American Red Cross, is no longer usable after 42 days. As a result, maintaining an adequate blood supply is a challenge-especially when a disaster occurs, which may cause the need for blood to soar. The only way to meet demand is to have regular donations from healthy volunteers.If you are healthy, your body-which has between 10 and 12 pints of blood-can easily spare about a pint, the amount that is collected at a donation. Because the body begins replacing donated blood immediately, most people can give blood every eight weeks. A person must be at least 17 years old in most states to donate their blood; this is because a person is generally considered an adult at the age of 17 and does not need parental consent to donate. The Minimum weight limit is 110lbs. The reason for this requirement is to protect the donor. A person under 110lbs may not tolerate having a pint of their blood removed because of how little they had to start with. This is important to know.

A large number of people in our society are on prescription medications but that does not always mean one cannot donate blood. If a person were on the following medications, they would never be allowed to donate their blood: Tegison, a human pituitary-derived growth hormone, Coumadin, or Heparin. Other medications such as Plavix, Accutane, Soriatane, and Avodart require that the donor wait to donate blood for 3 days to 3 years after their last dose. There are certain medical problems a person can have that would make them ineligible to donate their blood. A person who currently has or has had leukemia, lymphoma, Hodgkin's Disease, Creutzfeldt-Jakob Disease, hepatitis (caused by a virus) or hepatitis B/C, unexplained jaundice, HIV, or AIDS is not eligible to Donate blood. This is because there is a likely chance that the disease could be transported to the patient that receives the blood transfusion.

Conclusion

It is all the more important for any one to have some basic knowledge about the science of blood and blood donation as it is related to every other common man. It would be desirable for every educated to carry on the message to their counterparts so as to make the society as a whole better aware of the science of blood. All efforts, both the

Governments, and NGOs' have to be on this direction so that most of the medical and social problems could be averted. Prevention is better than cure, always.

Reference

1. http://www.letsfindout.com/subjects/body/rfipulma.html
2. http://www.watchtower.org/medical_care_and_blood.htm
3. http://www.letsfindout.com/subjects/body/veins.html
4. http://www.encyclopedia.com/articles/01579.html
5. http://www.letsfindout.com/subjects/body/rfiblood.html
6. "Blood"-EncartaEncyclopedia"BloodType"-EncartaEncyclopedia"Forensics"-Encarta Encyclopedia