



CONCEPT OF UNIVERSAL BLOOD CREATION

Sairam Pasam

Samskruti College of Pharmacy

ABSTRACT

Everyday 12000 people in India die due to sheer lack of donating blood, maximum percentage of people nowadays are suffering from diabetes, high blood pressure and obesity so they are not grouped under Donor category so we should find an alternative thing to overcome this problem, what if we can create universal Donor blood from other blood groups, yes we can do that this is modern ongoing research in which scientists use enzymes extracted from different microorganisms to Cleve the unwanted sugar moiety from A-negative and B-negative blood group to convert them in to O-negative which is universal donor, the main moto of creating universal blood is it can be transfused to anyone without having any complications.

BLOOD

*Blood is defined as a fluid connective tissue which circulate constantly providing nutrients and other requirements to the body parts.

*Blood transport oxygen, nutrients, hormones, clotting factors and protective substances.

*Blood is composed of straw-colored liquid called plasma in which several types of blood cells are suspended.

*Plasma consists of 55% of the blood and cell fraction is about 45%, blood cells are separated from plasma by centrifugation.

*Blood makes up about 7% of the body weight and plasma consist of 90-92% water and 8-10% of clotting factors, plasma proteins, inorganic salts, nutrients, hormones, gases and waste material.

ERYTHROCYTES (RBC)

RBC are most abundant type of blood cells in the blood, RBC are biconcave in shape and they are enucleated (lack of nuclei) and their diameter is about 7-micro meters being biconcave its surface area is more such that it can exchange large number of gases.

*RBCs are flexible such that they can squeeze through any small narrow capillaries.

*Being enucleated erythrocytes can't divide so they need to be replaced by new cells formed from red bone marrow, newly formed red blood cells will wear out after 120 days in the spleen.

*On an average human body consist of 30 trillion RBC, the process of developing new RBC is termed as erythropoiesis, on an average erythropoiesis take about 7 days which happen in red bone marrow, B6 and B12 vitamins are essential for the synthesis of red blood cells.

*Hemoglobin is the respiratory pigment present in the red blood cells which carry oxygen from lungs to different parts of the body, on an average single blood cell contain about 280 million hemoglobin molecules.

*Hemoglobin combines with oxygen to form oxyhemoglobin which transport oxygen to the various body parts.

DESTRUCTION OF RBC

The lifespan of RBC is 120 days upon ageing membrane of RBC became fragile worn-out RBC undergo hemolysis in the spleen which result in the formation of biliverdin and Fe+2 later the Fe+2 is transported back in to the blood which is later utilized in the red bone marrow in the formation of new red blood cells.

BLOOD GROUPING

Blood group of an individual is determined by the presence of antigen on the surface of RBC individuals can make antibodies against the antigens on the present on the surface of RBC.

*If an individual transfused with the same blood group processing the same antigen on the surface of the red blood cells, then the individual immune system will not recognize them as foreign particles and will not reject them, that's how transfusions will work.

*ABO blood grouping system is widely used to group an Individual blood, in India about 55% of the population have A-type or B-type antigen or both on the surface of the RBC remaining 45% have neither A and B type of antigen on the surface of the red blood cells (o-type).

*If antigen A is present on the surface of the RBC, then anti-B antibodies are present in the plasma.

*If antigen B is present on the surface of RBC the anti-A antibodies are present in the plasma.



*If antigen A and B are present on the surface of RBC then neither anti-A and anti-B antibodies are present in the plasma.

* If no antigen is present on the surface of the RBC, then both anti-A and anti-B antibodies are present in the plasma.

Type	You Can Give Blood To	You Can Receive Blood From
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-

*Blood group O-ve is known as universal donor because it does not contain any antigen on the surface of their RBC.

*Blood group AB is known as universal recipient because it does not contain any antibodies in the plasma to form an agglomerate.

RH-FACTOR

Along with antigens present in the surface of the RBC another antigen is discovered in the human RBC called Rh factor or Rhesus factor blood having this factor is known as Rh positive and the blood without this factor is termed to be as Rh negative.

*Almost 90% of the world population is Rh positive that means 90% of the population in India has Rh antigen on the surface of the RBC so it is advisable to test for presence or absence of Rh factor on the surface of the RBC before transfusion.

*If Rh positive blood is given to Rh negative patient for the first time no complications are seen but patient body will develop antibodies against Rh positive blood if the same transfusion happens for the second time it may lead to the death of the patient because of presence of antibodies against Rh positive blood which are produced during first transfusion.

* During child birth if father is Rh positive and mother is Rh negative then the mother who is Rh negative is carrying Rh positive baby in her uterus at first child birth there will be no complications because there are no antibodies against Rh positive antigen. At the time of delivery of baby small amount of blood from ruptured umbilical cord goes back into mother's blood in

which antibodies are synthesized against Rh positive antigen. When the mother is conceived for the second time Rh positive fetus will undergo hemolysis due to presence of antibodies against Rh positive blood this condition is called as erythroblastosis foetalis. At this condition Rh immunoglobulins are given to neutralize the antibodies thus we can avoid the risk of erythroblastosis foetalis.

NEED FOR CREATING ARTIFICIAL UNIVERSAL DONOR BLOOD

*In India for every two seconds there will be a need of blood in that way in a month we need 5-crore units to meet everyone's demands. Maximum blood transfusions are needed in surgical procedures and in hemorrhages that occur in trauma cases and in the treatment of blood disorders like Sickle cell anemia and thalassemia and many other blood disorders, people with blood disorders need blood transfusion once in 15 days or twice in a month.

*Nowadays maximum population is suffering from diabetes; high blood pressure and obesity so maximum percentage of population is not eligible and remaining half percent of the population is not willing to donate blood due to lack of awareness, to overcome these problems we need to find an alternative solution.

* What if we can convert every single blood group into O negative which is a universal donor? Then every blood group will become universal donor.

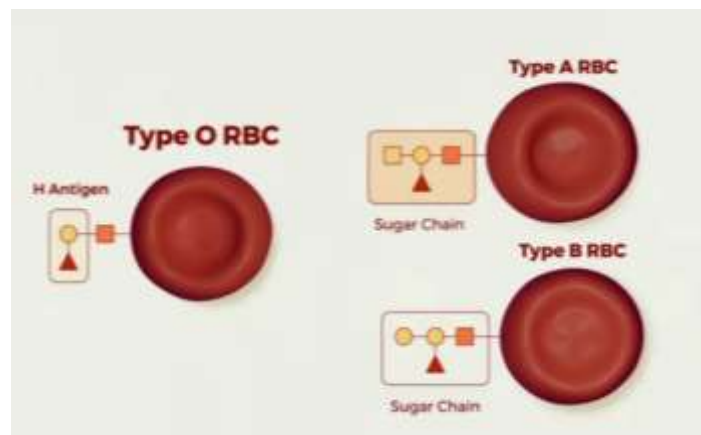


BLOOD TYPE	DONATE TO	RECEIVE FROM	% OF PEOPLE
O+	O+ A+ B+ AB+	O+ O-	39%
A+	A+ AB+	A+ A- O+ O-	31%
B+	B+ AB+	B+ B- O+ O-	9%
AB+	AB+	EVERYONE	3%
O-	EVERYONE	O-	9%
A-	A+ A- AB+ AB-	A- O-	6%
B-	B+ B- AB+ AB-	B- O-	2%
AB-	AB+ AB-	AB- A- B- O-	1%

*The table given up shows the percentage of people in India having blood group of O negative which is a universal donor, In India only 9% of the population have O negative blood group so blood donate by this blood group can be transfuse to anyone without any complications, but among 1393 billion 9% people can't fulfill the needs of 1393 billion people, so an alternative solution should be discovered to deal this problem that is by creating a procedure that can convert any blood group in to universal Donar group that is o negative.

HOW UNIVERSAL BLOOD IS CREATED

For every two seconds a person in the USA need blood but among 100 percent of the USA population only 30 percent of the USA population is eligible for donating blood among that only 10 percent of the actual population do blood donation, among 100 percent of USA population only 7 percent of the population is having O negative blood which is universal Donar according to the recent report given by red cross society USA has only 6 units of O negative blood for every hundred thousand people but in real more than twice is needed every day to meet the required demands.

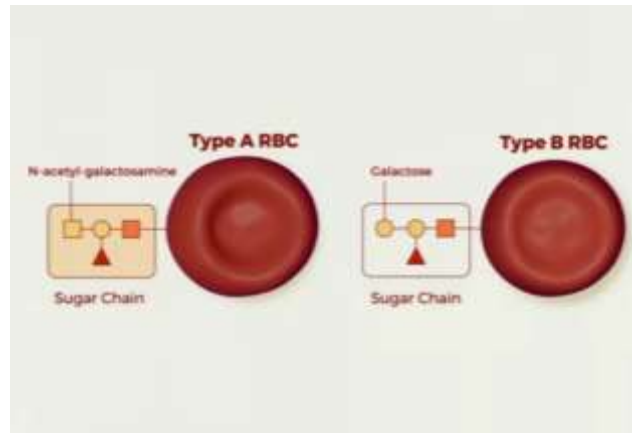


* O negative blood group can't produce any incompatibilities with other blood groups because it lacks both the antigens on the surface of the RBC so O negative blood group is called as universal donor.

* If we can turn any blood type to O negative then many complications in the blood donation network could be alleviated.

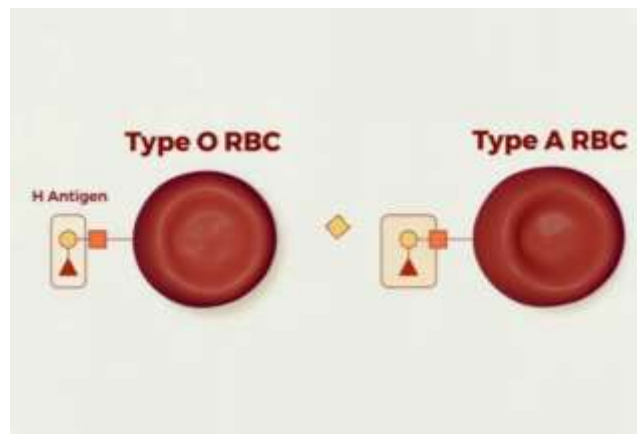
*In 1928 scientists first expressed the idea of turning ABO blood type in to O. A, B blood types differ from O by single

sugar chain so scientist believed that they can convert A-negative, B-negative blood types in to O-negative blood type such that it will become universal donor, however this procedure wont effect the Rh status of the blood.



*In 1928 scientist found an enzyme that can cleave an unwanted sugar chain from B-negative blood such that it can get converted in to O-negative blood which is a universal donor, The enzyme that cleaves the unwanted sugar chain from B-negative blood is alpha-galactosidase which is extracted from green coffee beans,

but this conversion requires the Ph of 5.7 which is slightly acidic and this Ph is not ideal for RBC that prefer a Ph of 7.4 and to this conversion large quantity of enzyme is required, As we know extraction and storage of enzymes are costly procedures.



Upon removing N-acetyl galactosamine mine from A-negative blood type it gets converted in to O-negative.

*Enzyme extracted from green coffee beans(alpha-galactosidase) is only capable of cleaving only B-antigen shows no effect on cleaving A-antigen, this is because this enzyme can cleave galactose of B-antigen but it doesn't show any action on A-antigen.

* This converted blood (B- negative to O-negative through the use of alpha-galactosidase enzyme) shows normal life span as natural O-negative blood.

*But only 10% of the population has B-negative type of blood even this theory is successfully applied there will be scarcity of B-negative type of blood, about 46% of the population holds A-negative type of blood this idea is not viable unit scientists found a new enzyme that can convert A-negative blood type to O-negative blood type.

*In 2007 researches selected 2500 types of fungi and bacteria any tried to extract enzymes from that that may convert A-negative blood type to O-negative blood type, in this process of

research scientists discovered two enzymes from two different types of bacteria that can convert A-negative blood type to O-negative blood type.

*Elizabethkingia Meningosepticum (bacteria that found in pond water)

*Bacteroides Fragilis (bacteria present in the human gut)

*The enzyme found in the gut bacteria can cleave the B antigen at Ph 7 and enzyme present in the river bacteria can cleave the sugar group after incubation of 60 minutes, after incubation A-negative and B-negative blood types are converted in to O-negative type.

*A cleaving enzyme is 30times less efficient than B cleaving enzyme

60mg of enzyme is required to convert 1 unit of A-negative blood type to O-negative blood type.

20mg of enzyme is required to convert 1 unit of B-negative blood type to O-negative blood type.



*Recently scientist found an enzyme that can Cleve unwanted sugars from A-negative type of blood to convert it I to O – negative type.

* FpGaINAC deacetylase and FpGalactosaminidase these two are the enzymes that are extracted from the bacteria Flavonifractorplautii these two enzymes are capable of converting A-negative blood type to O-negative blood type, 1milligram of enzyme is enough to convert 1 unit of A-negative blood to O-negative blood which is universal donor.

*Scientists nowadays using metagenomics to identify the bacterial species that can Cleve blood sugars.