Human Physiology
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Week - 02
Lecture - 05

Hello everyone, welcome to our brand new classes of human physiology. Hopefully, you are enjoying the last few classes of blood, blood coagulation pathway, anticoagulants and different type of blood related disease what we have discussed. In today's class, we will see like about blood transfusion, various type of blood grouping and which groups are kind of compatible to the donor, so donor and receptor. So, all these things we will discuss in this class. So, what are different contents for today's class? We will see is like what is ABO blood typing or prototyping. So, different type of like ABO blood related groups.

Then we will discuss about Rhesus or Rh antigen. We will discuss about hemolytic disease that can happen during the pregnancy or newborn. We will see blood transfusion, why blood transfusion is needed, which groups can as a donor can give their blood to the receptor without any complication and then we will also see different hazards of the blood transfusion. So, blood groups are like mostly this blood group categorization or the classification are done by the antigens presence on the blood cell ok.

So, agglutinogens or antigens that are presence on the cell membrane of the RBC by which mostly the classifications are done. And then two terminology are very important here. So, you remember one is the agglutinogen which is the antigen that is present on the surface of the RBC and then the next important terminology is the agglutinin. What is agglutinin? Agglutinin is the antibodies present against the agglutinogen or the antigen. So, this is very important and what happens like agglutination of the RBC can cause if like the antigens that are present on the surface of the RBC of the cell membrane actually presented towards a suitable antibody.

So, if the right antigen is presented to the antibody, then like a vigorous aggregation type of reaction can happen. What can happen? or agglutination can happen that will basically form like clumps of RBC together. So, all the RBC will get like clumped. And it will form like big, big, big clots, larger thrombus and clots in the body. And what will happen basically, like bloods will kind of completely clotted and within maybe few minutes to hour the patient can die due to like lack of oxygen flow.

So, this is a serious kind of condition we have to, that is why properly prototype like different blood groups and very well we have to know that which donor can actually leave blood to the receptor. okay so what are different types of blood group mostly there are four type of blood groups right so what are different type of blood group mostly we have four different type of blood group one is A then second is a B then third is AB, fourth is O, ok. So, A, B, AB and O, there are these four type of blood group mostly these are common, ok. So, what is blood group A? In cases of blood group A, what you will observe? We will observe like the A type of antigen. So, you can see on the top of the RBC, we will see some antigen.

So, these antigens are A antigen on the surface. And because A antigens are present on the surface of the RBC, these groups are called type A or blood group A. But for this type of people which have this type A type of antigen, they do not have like any antibody A, but they have

antibody B in their plasma or in their blood. So, what they have? They have antibody B in their blood. So, try to remember in case of prototype A, they have the antigen A on the surface of the rbc but in their plasma or in their blood they don't have any antibody a what they have they have antibody b okay and then in cases of blood group b then what is present blood group B has like antigen b present on the surface right you can see that The antigen B is present on the surface of the RBC and what type of antibody will be present on the plasma? They will have the antibody A type.

So, they will have antigen B and antibody A. The next group is the AB. So, for AB, what will be there? For the AB, both antigen A and antigen B are present. So, for the AB group both antigen A and antigen B are present on the surface of the RBC and for this reason like AB group they cannot donate their blood because they have both these antigen on the surface of the RBC. So, if they donate their blood to any other group apart from the AB what can cause like there is a significant type of aggregation or agglutination can happen.

okay so that's why AB cannot donate blood to any other group apart from itself okay and then what other like antibody they will have they will have no antibody present so they don't have any antibody a also they don't have any antibody B also in those patient so in that case what will happen like AB blood group can accept blood from any other group okay So, AB blood group is the universal blood acceptor because they do not have any antibody present in their body, they can easily kind of take the blood from any other groups. So, for AB although they cannot donate their blood apart from AB group, but they can accept the blood from any other group like AB or O. And then the last one is the O group and this is like if you kind of see O group is the most common blood group at least in the Asiatic kind of genetic condition. But mostly we will see like all over the world also O group has more than maybe like 70-80% of the people carrying this O group of blood. And in case of O blood group, there is no antigen present.

So, no antigen A, no antigen B. What that means? Because then, because they do not have any antigen either A or B in their RBC, they can give blood to anybody. So, because there is no antigen present, they become like the universal donor. because no antigen like A or B are present on the surface of the RBC, blood group O becomes the universal donor, they can donate blood to any other group including themselves. But problem is that the O blood group holder people have both the antibody A and B present their plasma and in their blood and that becomes very problematic because if you give blood from any other blood group which will carry either of antigen A or antigen B or both of the antigen that can cause a severe reaction or agglutination in the body causing death.

So, O blood group holder people cannot receive blood from any other blood group apart from the O itself but they can donate blood to anyone and that is why it becomes sometime difficult that you have to only find like the O blood group holder they can only donate blood to the O group holder okay so that is i hope you could understand now So, just to recapitulate one more time, the type A, what it has, it has A antigen present on the surface of the RBC, right. and it has the antibody B in the plasma or in the body then type B type B what is that it has B antigen present on the surface and it has anti A antibody in the plasma or the body type AB both the antigen A and B's are present on the surface and that's why AB blood group cannot be a donor so AB blood group cannot be a blood donor apart from their own itself they can only donate to AB group people But they can accept blood from everyone why because there is no antibody A or B present in their plasma or in their blood. So, they can accept blood from any other group and the last one is the type O. So, neither A or B antigen you can see the structure here there is

no antigen present. So, no antigens are present on the surface of the RBC for type O that means they become the universal donor so they become universal donor they can donate blood to any other blood group but because the problem is what they have both these anti-A and anti-B antibody in their plasma or in their body that creates a challenge so that all these three other group all these three group cannot donate blood all these three group cannot donate blood to the o group so O group can only accept blood from the O group itself okay and that's why it becomes like a universal donor but unfortunately it cannot accept any blood from other groups okay hopefully you understood this all the prototyping Then next is very important is Rh or recessed antigen.

So back in almost 1940, this is also another type of antigen, like A antigen, B antigen, Rh is also another type of antigen. There are several antigens that are present in top of RBC cell. So Rh antigen was first discovered by Landsteiner and Weiner back in 1940. okay these antigens are responsible or for like the blood grouping system to be referred as Rh antigen or Rh factor okay so basically we will see this plus or minus right for example like a plus group or a minus group or like o plus group or O minus group so this plus or minus is coming from either Rh+ or Rh- so Rh if it is present on the surface of the rbc it will be called as plus and if there is no Rh group present on the rbc or the Rh antigen is absent then it will be called as negative group okay and the Rh term refers to like D antigen okay these are mostly like the integral membrane protein So, mostly we will have now two type of group one is Rh positive which has this D antigen and then there is like Rh- group which does not have any type of D antigen on their RBC. So hemolytic disease because this associated Rh it got discovered because of this severe issue during the pregnancy or the newborn.

What happens basically like if the Rh plus and Rh minus blood that get mixed then there is like a immediate significant reaction and hemolysis happen. What happens? lysis and what is this hemolysis basically your biconcave shaped RBC gets lysed it gets burst out and all the content of the RBC will come out of the cell right basically a lysis due to the burst out of the cell and this when it happens if both Rh plus and Rh minus blood get mixed then this kind of situation can happen and when like how you how you will understand like this type of how you can predict basically like who will be vulnerable during like pregnancy. So, basically what happens is like if the mother is Rh negative right let us consider the mother who is Rh negative now the newborn baby or the carrying fetus can either have Rh positive or negative right so either the carrying newly carrying baby or the fetus can carry Rh positive or Rh negative blood now consider that the mother is Rh negative now what will happen in cases of Rh negative offspring in cases of Rh negative offspring there is no problem because this is a compatible. But if the newborn baby or the fetus is carrying the positive Rh positive blood and immediately when it will come close to this Rh negative blood of the mother significant hemolysis reaction will cause and eventually like both fetus and the mother can die. So, this is a very like life threatening situation and this can be cured what happens is like you can give like a Rh positive antibody what you can do you can give the Rh positive antibody Rh positive antibody of the fetus right before like its blood gets kind of mixed with the mother so basically a single dose of Rh antibody or anti-D or in in form of like Rh immunoglobin can be given to the mother after soon after the child born okay in that way what will happen the anti antibody of this Rh or the anti D antibody it will destroy any present like Rh antigen So, if this antibody destroys like any antigen, Rh antigen present in the blood, there will not be any vigorous reaction or any hemolytic event.

So, especially it can be seen during the first pregnancy where the fetus is carrying, you can see the fetus is carrying the Rh plus blood and the mother is having the Rh minus blood. the mother

is having the Rh minus blood and whenever there is a mix of this Rh minus mother blood to the Rh plus fetus blood a significant aggregation hemolysis event can cause. So, between pregnancy basically what you can do is like this anti Rh antibodies right they are getting like developed during the pregnancy to the mother. Now in cases of any complication an anti D antibody can be given to the mother soon after the pregnancy that will destroy like any antigen and there would not be any consequent reaction causing no adverse event. So, these antibodies play a very important role to destroy like the Rh positive antigen of the RBCs of the fetus.

So, please remember this is a very important kind of information. And then finally blood transfusion. So why do we need blood transfusion? It is like you are donating the blood and if you need new blood, it can be due to many things. It can be due to like cancer.

It can be due to anemia. It can be due to any external injury. For example, if any accident happens, you can lose a significant amount of blood. As you know, we have only a limited amount of blood present in our body. How much? It is about 4 to 5 liters. So, in cases of any accidental injury or cancer or anemia, if you observe a blood loss, Then it is important to supplement that blood immediately because in cases of too much of delay of new blood production oxygen supply will be severely hampered that can cause coma eventually death also.

So, blood needs to be transfused from a donor to the receiver who needs of the blood, but as we went through like this different type of antigen antibody reaction, you have to remember that proper prototyping is needed and a right donor only should be able to give the blood to the receiver. If there is a mismatch of the donor and receiver, there can be a significant challenges causing the life threatening even death. So, this is like the overall chart you can see. So, this in top you can see these are the donor blood group. So, how we are categorized? We categorize first like if the four blood group we have right O, B, A and AB and then in terms of like RH factor if the RH factor is not present then O negative, if the RH factor is present then O positive.

So, in case a total then eight prototyping or total eight groups we have created. which are different four groups along with the Rh factor now you can see that O minus because it doesn't have any Rh antigen also O minus can give blood to all the group okay so this is actually truly speaking the universal donor okay so in real sense if we ask you that which is among the all group is the universal donor it is not the O in general because O plus cannot give blood to all the group it is the O minus because it does not have any antigen present on the surface and also it does not have any antigen A or antigen B present on the surface so basically O minus doesn't have any A antigen any B antigen any Rh antigen these all the three antigens are not present on the surface and that's why O minus blood group holder can donate their blood to any other group so this is in true sense is the universal donor okay O plus can give blood to the all the positive other group but because they have Rh plus antigen so O plus still has the Rh plus antigen so they cannot give blood to the Rh negative groups but they can give blood to all the other positive group and then B minus can give blood to either AB or the B groups, B plus only can give blood to the plus groups, A minus can give blood to either AB or A groups like either a plus or minus. A plus only can give blood to the plus groups not to the minus groups. AB as you know AB minus can only accept blood from the AB plus and AB minus and AB plus sorry AB minus can only give blood to like AB plus and AB minus right and AB plus this is like the one of the donor that hardly can donate their blood right. So, AB plus can only donate blood to AB plus receiver because it has both antigen A, it has both antigen B along with it has the recess antigen.

So, all these three antigens are present in the AB plus blood group donor and that is why they cannot donate blood to any other group see they cannot donate blood to any other group apart from itself like apart from AB plus holder receiver. But you can see that AB plus receiver can accept blood group from everybody. So, AB plus, so in cases of AB plus as you know like all the three antigens are present and there is no antibody regarding A and B's are present there. So, AB plus group in true sense they are called the universal acceptor. okay so AB plus group can accept blood from all that groups respective of Rh plus or negative they became the they became the universal blood universal blood receiver right so AB plus blood group becomes a universal blood receiver and same way O negative group becomes the universal blood donor.

Hope you kind of understood this chart and there will be lot of important questions regarding the blood donation or blood transfusion compatibility to your exam. So you just have to remember the chart and ensure that the right blood donor group is only giving the blood to the receiver because in cases of mismatch agglutination or aggregation or hemolysis can happen causing mortality. So right what different precautions need to be taken the right donors we have to choose right. So we have to choose and match and cross match between the donor and the receiver. right so between the donor and the receiver we have to ensure that there is a proper match increases of cross match what will happen aggregation hemolysis everything can happen also we have to ensure Rh compatibility because if it is has Rh plus we cannot give blood to the Rh minus Rh plus only can give blood to the Rh plus only Same way Rh minus group can only give blood to the Rh minus but it can also give blood to the Rh plus group because it does not have any Rh antigen.

So, Rh minus blood group can give still give blood both to the negative and positive but unfortunately in cases of Rh positive groups it can only give blood to the positive and it cannot give blood to the Rh negative groups okay and finally also you have to ensure donor doesn't have any other disease right because if the donor is carrying any other disease so giving the transfusion and blood to another patient can cause like carrying those disease to that new patient so before the transfusion happens we have to check their previous history you have to match their blood groups so that no cross cross match can happens causing hemolysis apart from that you have to also ensure that they are not carrying any other blood related disease that can cause problem later to the new receiver So, apart from that you have to ensure that all the apparatus should be sterile so that during the transfusion no bacterial or other type of like fungal contamination can happen or microbial contamination can happen because that can also cause like infection to the blood or immune shock to the blood. So, those can be also detrimental causing like severe type of reaction in the body even death. Temperature of the blood should be maintained. We cannot give like cold blood or like too warm blood. It should be properly maintained to our body temperature and transfusion finally the process should be also slow.

It should not be too fast because transfusion of the blood at a rapid rate can cause like a significant increase of the blood pressure and that can damage the blood capillaries to our body. So, the transfusion speed should be maintained in a slow and sustained manner. So, what are different other hazardous like transfusion reaction in cases of any mismatch hemolysis allergic reaction can happen if the equipments are not sterile enough bacterial viral microbial infection can happen too much of blood transfusion can cause also like iron overload and iron related like toxicity. right apart from that blood clotting issues can happen immune sensitization allergy can happen over volume of fluid can cause like edema type of situation and finally like electrolyte imbalance can also happen so these are several type of challenges and of course like each of these can be tackled in a professional manner by the respected doctors who are well

aware of this situation So, I hope you like the class. So, think about it that a patient with blood type AB minus.

So, a patient with a blood type AB minus needs a transfusion, but only O minus blood is available. So, the patient with the AB minus blood group, he went or she went to a hospital, but the hospital only has O minus blood. So, a transfusion, can it happen or not? So, try to solve this. Again, why can people with O negative blood group donate to all blood type, but only receive O minus blood to themselves? So, can you answer these two questions? and that's why we say like O minus is very rare right more often sometime you see like whatsapp messages or your friendly like calls or messages by asking like O minus blood groups because if any O minus blood group they require blood they can only receive blood from the O minus blood group only not from other and that becomes a challenge because O minus is a very rare blood group so I try to answer these two questions okay And you can refer these textbooks and thank you again for attending this exciting classes of blood prototyping and blood transfusion and related all these hazardous and complications.

Hope you enjoyed the class. If you have any further questions, please drop the email with your questions and we will also do like live interactive session. We can clear your doubt. Okay, let's meet with another new classes of human physiology in our next class. Thank you and hope you enjoyed the class. Thank you again.