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A review on animal blood as an artificial blood for humans

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Abstract
In 1667 a physician called JEAN-BAPTIST DENIS performed a blood transfusion from sheep to a patient who is suffering from fever. Before that in 1665 he transfused blood between two dogs. PAUL EMMEREZ a surgeon helped Denis to transfuse blood from animal to human. A 12 years old boy suffering from fever there is an emergency need of blood and he started to transfuse animal blood to human to that little kid. He succeeded in that but there are more side effects because of using this animal blood like back pain, black urine and some chronic side effects. In 1818 JASMES DLUNDELL performed human to human blood transfusion succeeded in some patients and failed in many. But later in 1901 KARL LANDSTAINER discovered the different types of blood groups so DLUNDELL failed in many cases during transfusion of blood from human to human. From then transfusion of blood became far easier than in early 16 hundreds. But anyway there is no artificial blood has been discovered yet. Many scientists have concluded that artificial blood cannot be discovered. Even there is an animal which is compatible for human it shows many side effect. Except the lug worm every creature will have antigen. So, scientists began to research on it and still failing. There are several reasons like organ incompatibility.

Keywords: Animal blood, artificial blood, plasma

Introduction

Scientists try to make animals to human transfusions but the animal blood is not compatible to humans so they stopped transfusing blood from animals to humans. Recently the research is going on about using pigs blood to transfuse into humans so it is more compatible to humans. Previously many scientists tried this process with the blood of animals like calf, goat, sheep and even cows. This led to many side effects even death to some patients. The reason behind this severe side effect is lake of knowledge in blood composition and it types. Later in 1900 KARL LANDSTAINER introduced blood types and its composition and it is a wonderful turning point for animal to human blood transfusion. But in recent days, the human population is confronted with a shortage of blood to transfuse and researchers are turning back to animal research to find solutions to this critical health problem and make blood donations. A blood substitute derived from cow plasma was given to a woman to save the life of her whose religion forbade conventional blood transfusion in 2011. This artificial blood was designed to increase oxygen transport in the body after heavy blood loss.

Fig 1: Illustration of an early xenotransfusion from lamb to man

Methods

Marine Lugworm Blood is a Universal Donar

Marine lugworm breathes with gills same as like fish. They can actually survive under the water for 6 hours. This is all because of its hemoglobin and it proteins which carries oxygen. The oxygen in these lugworms is 40 times more oxygenating than in humans. In human blood each hemoglobin protein molecule will hold 4 oxygen molecules but, in lugworms each protein molecule of hemoglobin will hold approximately 158 O2 molecules according to research of frank zal. These lug worms blood is more unique than any other animals there are no antigens found in it that are responsible for blood types. So it was proved to use as human artificial blood. Zal has set his sights on other uses for lugworm blood such as worm blood bandages to treat chronic wounds, or a hemoglobin-based oxygen carrier that could be used to treat sickle cell anemia and even a gel-like oxygen carrier as a promising therapeutic solution for the treatment of periodontitis.

Transfusion of Pig Blood to Humans

The potential for using genetically-modified pigs as sources of RBCs is significant. Pig RBCs share a number of common characteristics with human RBCs with similar cell diameters and counts, although the average life-span of pig RBCs is shorter than that of human RBCs. Porcine hemoglobin shares only 85 percent sequence identity with its human counterpart. Nevertheless, both pig and human hemoglobin have similar 3D structures, and it is believed that most of the 22 and 21 amino acid substitutions on the alpha and beta subunits, respectively, have no significant functional effect. For example, human alpha-hemoglobin chains hybridize with pig beta-hemoglobin chains *in vivo*; however, the opposite only occurs *in vitro*. It appears that despite subtle differences in structure affecting stability and function, the molecules are functionally competent. The most closely studied pig blood group system is the A-O (H) system, which is loosely related to the human ABO system. Pig herds have been developed that are uniformly of blood type O; thus, ABO compatibility between human recipients and 'donor' pigs can be assured. Furthermore, human hemoglobin has been expressed in transgenic pigs, with normal post-translational modifications and biological function.

The high breeding capacity of pigs and the ability to produce them in a designated pathogen-free environment obviates many of the potential infectious risks of human RBC transfusion. Moreover, pRBCs do not have nuclei, and therefore do not harbor porcine endogenous retroviruses, although this advantage would be reduced by contamination of the product by leukocytes. Nonetheless, the use of white blood cell filters could feasibly ensure that leukocytes do not contaminate pRBCs, simultaneously preventing the theoretical risk of PERV transmission, as well as leukocyte immunogenicity. Most experts now agree that with the necessary established screening protocols, and requisite biosecured housing for source pig herds, the risk of porcine xenotransplantation spreading communicable diseases is minimal Pigs express antigens that correlate with human A or O blood group antigens, but only blood group O pigs are used in the field of xeno transplantation. Pigs have a single Rh gene that does not appear to represent a blood group antigen. The many 'minor' blood group antigens that have been investigated do not appear to be expressed on pig RBCs. Still, investigation of additional variant antigens may need to be explored to prevent potential rejection or immunization from developing, as seen in allogeneic transfusion. The presence of antibodies to human leukocyte antigens is not uncommon in patients who have been exposed to blood transfusion, organ allo transplantation, or pregnancy. Increasing evidence suggests that some humans have anti-HLA antibodies that cross-react with swine leukocyte antigens. However, swine leukocyte antigen is not expressed on pig RBCs and so will not be problematic.

Three major carbohydrate antigens are expressed on pRBCs against which humans have natural antibodies, namely Gal, Neu5Gc, and Sd^{a}. The major target antigen for primate natural antibodies is Gal, a terminal oligosaccharide similar to the human blood group A, B, and O saccharides. Like anti-A/B antibodies, anti-Gal antibodies are believed to develop during infancy as a response to colonization of the GIT by various bacterial and viral flora. Human natural antibodies to two other carbohydrate epitopes have been identified, although the cytotoxicity associated with these antibodies is relatively reduced compared to anti-Gal. Nevertheless, they can initiate lysis of pig cells *in vitro* and cause rejection of pig organs in NHPs. Therefore, if pig RBCs are to be transfused successfully into humans, RBCs from triple-knockout pigs will be required, in which all three of these antigens have been deleted. The current evidence is that many patients awaiting kidney allograft have natural anti-pig antibodies directed only to these three known pig antigens, although there may be other minor, unidentified carbohydrate xenoantigens in the remaining members of the population. A comparative analysis of human antibody binding to pRBCs isolated from G TRIPLE KNOCK OUT, double-knockout, and triple knock out pigs, as well as autologous and allogeneic human RBCs, has been carried out. Human antibody bound less to triple knock out pig RBCs than to allogeneic human RBCs in 43% of samples, with varying but minimal binding in the remaining specimens. This demonstrated that triple knock out dramatically reduces or eliminates the xenoantigenicity of these pigs RBCs. In the absence of human serum antibody binding to triple knock out pRBCs, survival of the pig RBCs after transfusion would likely be prolonged. This would be a result of reduced antibody-mediated cell loss, and reduced phagocytosis. Therefore, in some patients, transfusion of triple knock out pig RBCs may be sufficient to obtain clinically-relevant prolonged survival of the pig RBCs.

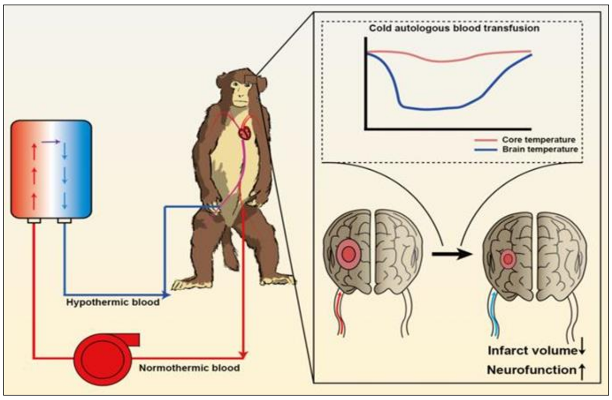

Fig 2: Cold autologous blood transfusion

Other Compatible Animal Blood for Transfusion

Baboons and other Old World monkeys have been established as reliable surrogate hosts in xeno transplantation models because they express comparable proteins to humans. Perhaps more importantly, they lack certain carbohydrate antigens as do humans, and therefore develop similar anti-pig antibodies. For example, other Gal or Sd^a, and therefore produce anti-Gal and anti-Sd^a antibodies. For these species, therefore, double-knockout pigs lacking Gal and Sd^a will be required for *in vivo* experimental studies of pig RBC transfusion. However, Old World nonhuman primates differ from humans in one important respect: they do express Neu5Gc, and therefore do not make anti-Neu5Gc antibodies. Alternatively, the capuchin monkey mimics humans same with respect to the antibodies developed against Gal, Sd^a, and Neu5Gc expressed on pig RBCs. Therefore, New World monkeys may make a preferable experimental model for studying the comparable human antibody response to triple knock out pigs RBCs *in vivo*.

Conclusion

Many scientists have concluded that artificial blood cannot be discovered. Even there is an animal which is compatible for human it shows many side effect. Except the lug worm every creature will have antigen. So, scientists began to research on it and still failing. There are several reasons like organ incompatibility. Some animal blood is not compatible for the human organs even if it does not show side effects for some days. So in many countries animal to human blood transfusion has been banned. Now across the world human to human has been began and bring a great and tremendous changing in the world.

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