Scholars Academic Journal of Biosciences (SAJB) **ISSN 2321-6883**
Sch. Acad. J. Biosci., 2013; 1(3):96-97

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sajb.2013.v01i03.008

Short Communication

Artificial Blood and Biotechnology; Finding Alternatives to Blood Transfusion

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Abstract: The objective of this short communication is to collect some information about alternatives to human blood and thus it can be informative and make a ray of hope for peoples for requiring urgent blood, having trouble in transfusion. Soon after discovery of blood it was perceived that diseases could be cured and even personalities could be changed by replacing blood. But many documents evidences are there for deaths and causilities in normal blood transfusion. There fore, search for alternatives is always there. Currently, some biotechnological products like Perfluorocarbons, HBOCs (Haemoglobin Based Oxygen Carriers), plastic blood etc studied at preclinical and clinical phases and in near future they can replace human blood. They can make comfortable and can decreases cost and death.
Keywords: Blood Alternatives, Perfluorocarbons, HBOCs (Haemoglobin Based Oxygen Carriers), plastic blood.

Introduction

William Harvey was the first scientist who described the circulation of blood in 1616. Soon after this discovery, scientists started thinking whether blood could be replaced with other liquids, for example wine or milk. It was perceived that diseases could be cured and even personalities could be changed by replacing blood. As a consequence, some interesting yet disappointing results became obvious. In 1667, first documented human transfusion was made[1] but many recipients died following the course of blood transfusions. No real progress took place until 1901 when Karl Landsteiner, an Austrian immunologist and geneticist, discovered various blood groups[2]. This discovery made blood transfusions a routine procedure. Improved collection and screening methods have made blood safe which can now be stored for up to 35 days.

Blood alternates

There is a constant demand for blood replacement as lots of individuals bleed due to serious injuries. The quest to produce artificial blood that can be infused safely at any time and at any place with long shelf life, regardless of the blood type has remained a focal point and billions of dollars are spent over the last 20 years globally in an attempt to create an alternative to blood. Artificial blood could be used for gaseous exchange and to carry out other vital tasks in the cardiovascular system. The most suitable blood alternate should have some characteristic features involving cost effectiveness, volume expansion, minimum adverse effects, increased shelf life, free of TTI and the oxygen carrying capacity. The other terms commonly used for blood alternates are blood substitutes or blood surrogates. These terms are not appropriate since no existing substitutes can perform other vital functions of blood including immune defense and clotting. The blood alternates currently being developed are shown in Fig 1. Colloid based volume expanders are Voluven, Haemaccel, Gelofusin etc., while crystalloid based volume expanders include Ringer's lactate and Normal saline. Both of these volume expanders raise the quantity of blood.

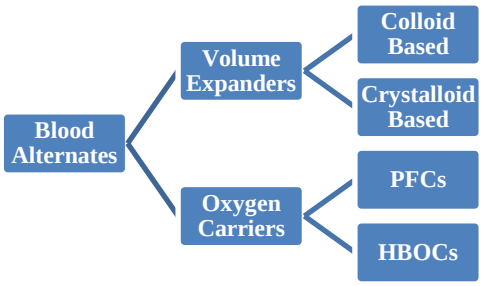

Fig 1: Blood alternates

PFCs (Perfluorocarbons)

These belong to the oxygen carriers/therapeutics category, are being developed but have not been marketed yet. These are mixed with different materials such as vitamins, antibiotics, various salts and nutrients making it similar to blood in composition. Because of their small size and easy travel through blood capillaries, the PFCs are comparatively better in performance than red blood cells. PFCs are very cost effective and contamination free because their synthesis does not require any biological material. The material involved in synthesis of PFCs is biologically inert with a capacity to dissolve about 50 times more oxygen than blood plasma. However, PFCs encompass certain shortcomings the most significant is that PFCs are water insoluble so they ought to be combined with emulsifiers such as lipids which help to suspend PFCs molecules in the blood. First PFC was introduced in market in 1989 by Green Cross Corp. of Osaka, Japan [3], with brand name Fluosol but it was withdrawn in

1994 because the beneficial amount required was too high.

HBOCs (Haemoglobin Based Oxygen Carriers)

Thisrepresent an interesting class of oxygen carriers, which are undergoing advanced clinical trials. The function of hemoglobin is to carry oxygen from the lungs to the other tissues in the body. Same principal is exploited by artificial blood based on hemoglobin. HBOCs utilize haemoglobin, the same oxygen-carrying protein molecule found in blood but this haemoglobin is not contained within a membrane in HBOCs unlike the red cells and in addition, these have a longer shelf life. But still there are certain risks associated with using the free haemoglobin (toxic effects). The flow of oxygen from to blood to the cell could be altered when oxygen is being delivered by a cell-free carrier instead of red blood cells. However, haemoglobin could safely be extracted and utilized by standardizing processes like recombinant DNA technology, self linking, polymerization and encapsulation. The general benefits of HBOCs over transfused RBCs [4] are faster and better O_2 distribution, ready to use, long shelf life, universal compatibility, no equipment or refrigeration and can also be use by Jehovah's Witnesses*. Most of the HBOC products are currently at the final phase of trials prior to submission for FDA approval.

Since oxygen therapeutics are currently limited, scientists are also trying to develop an artificial 'plastic blood'[5] which could act as a substitute for real blood in emergency situations and have huge impact with regards to military applications. Because the artificial blood is made out of plastic, it is light weight and easy to store. Cost could be a major restriction but it would ultimately adjust as manufacturing will become refined after clinical evaluation stage. There are also some reports that researchers have used dried blood, which takes up less room, weighs less and can be used for longer period of time compared with blood plasma. The powder can then be mixed with saline when needed. Blood transfusion is an essential component of health care. Every country shares the need to ensure the quality, safety and accessibility of blood transfusion. In developing countries, blood transfusion services have traditionally been conferred low priority in health care services. As a result, an absence of adequate and nationwide access to safe and affordable blood supply is observed in general. Hence, there is an urgent need for these blood substitutes because of risks associated with blood transfusions and pending worldwide blood shortages. The future advancements in biotechnology, biochemistry and genetic engineering can play a promising role in generating an effective blood substitute, which will definitely have a significant impact on transfusion medicine. Reaching into the unforeseeable future, we can only hope that eventually blood substitutes will be able to cover worldwide blood shortages, and will be cheap and stable enough to be distributed safely in third world countries where much of the blood supplies are contaminated and poses a threat to blood safety. This new alternative system of blood transfusion with ongoing molecular approaches will confer a new dimension to transfusion medicine. Let's hope that no patient dies due to unavailability of blood.

*Jehovah's Witnesses believe that the Bible prohibits ingesting blood and that Christians should therefore not accept blood transfusions or donate or store their own blood for transfusion. This religious group advocates of what they call bloodless surgery.[6].

Conclusion:

By this short communication, it can make realization and develop a hope for artificial blood which will reduce mortality, cost and time to get blood.

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