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Review Article

A REVIEW OF ARTIFICIAL BLOOD

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ABSTRACT

Artificial blood is a product made to act as a substitute for red blood cells, blood substitutes are used to fill fluid volume and/or carry oxygen and other blood gases in the cardiovascular system. More accurate terms are volume expanders for inert products, and oxygen therapeutics for oxygen-carrying products. It is required to overcome the Hypovolemic Shock During Accidents, Surgery Etc..,. Ideal blood substitute should have Universal compatibility: elimination of cross matching, Pathogen free, Minimal side effects, Survivability over a wider range of storage temperatures, Long shelf life, Cost efficient etc. Their main function is replacing lost blood volume and oxygen carrying capacity. Haemoglobin-based oxygen carriers vaguely resemble blood. Two major areas of research in this Endeavour are Hemoglobin-based oxygen carriers (HBOC) and per fluorocarbon -based oxygen carriers (PFBOC). These can reach tissues more easily than normal red cells and can delivery oxygen directly and extensive clinical trials are being conducted to their safety and efficacy.

Keywords: Artificial blood, Haemoglobin-based oxygen carriers, Perfluorochemicals.

INTRODUCTION

Artificial blood is a life saving substance that carries oxygen to the body when there is a shortage of red blood cells .Artificial blood has properties that make it more versatile than real blood, including long shelf life, no need for refrigeration and the ability to sterilize. Artificial blood does not need specifically matched type .It is also called as blood substitutes.Thehalf life of blood is 42 Days and it is High Levels of Nitric Acid Packed in it.

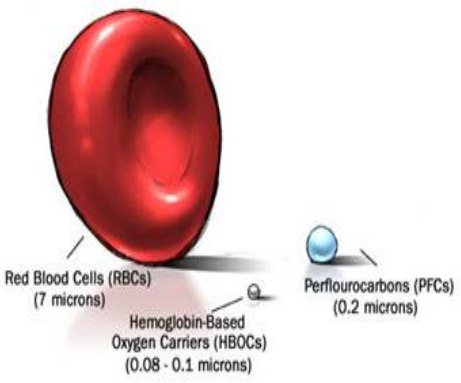

Fig. 1: Artificial blood substitutes

HISTORY

1. William Harvey discovered blood pathways in 1616 .Many people tried to use fluids such as beer, urine, milk and animal blood as a blood substitute.
2. The first approved oxygen carrying blood substitute was a Per fluorocarbon based product called Fluosol-DA-20 .Manufactured by Green cross of Japan. It was approved by the food and drug administration in 1989.
3. In 1990's Haemoglobin based oxygen carriers called Haemopure was approved for phase-3 trail.
4. In December 2003 new Haemoglobin based oxygen therapeutic called Polyheme was introduced.

IDEAL CHARACTERS OF ARTIFICIAL BLOOD

1. Safe to use.
2. Compatible in the human body.
3. Able to transport and release oxygen where needed.
4. Is free of pathogens and toxins which would produce an immune system

response in the human body.

5. Blood substitutes or synthetic blood are currently labelled as "oxygen carriers". This is because they are unable to mimic many of the other functions of blood. They do not contain cells, antibodies, or coagulation factors. Their main function is replacing lost blood volume and oxygen carrying capacity.
6. The ideal blood substitute could be defined by the following terms:
7. Increased availability that would rival that of donated blood, even surpass it
8. Oxygen carrying capacity, equaling or surpassing that of biological blood
9. Volume expansion
10. Universal compatibility: elimination of cross matching
11. Pathogen free: elimination of blood contained infections
12. Minimal side effects
13. Survivability over a wider range of storage temperatures
14. Long shelf life
15. Cost efficient.

PROBLEMS ASSOCIATED WITH ARTIFICIAL

1. Body immune systems may sometimes react negatively to the foreign blood that is inserted into the body.
2. Trauma patients are often frequent recipients of blood substance or plasma during surgery, it becomes challenging to understand which types of blood substitutes have affected which problem in the patient's body.

COMPOSITION OF ARTIFICIAL BLOOD

1. Perfluoro-octyl bromide - 28%
2. Fo-9982 - 12%
3. Yolk lecithin - 2.4%
4. DSPE-50H - 0.12%
5. Distilled water - 57.48%

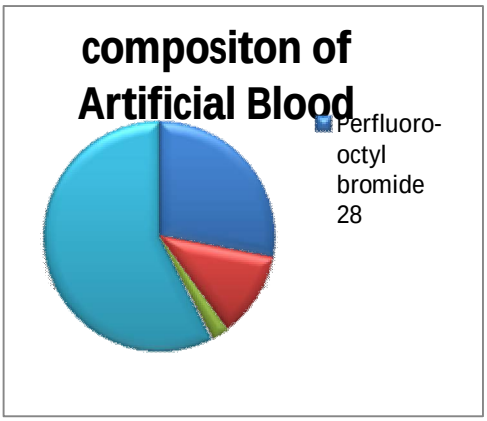

Chart No. 1:

TYPES OF BLOOD SUBSTITUTES

1. Perfluoro carbons (PFC) emulsions
2. Haemoglobin based oxygen carriers (HBOC'S)

1. PERFLUORO CARBONS (PFC) EMULSIONS

1. PFC'S are derived from a group of hydrocarbons in which the hydrogen atoms are replaced by fluorine atoms.
2. These are chemically inert due to the strength of the carbon-fluorine bond.

PREPARATION

Water, salt and phospholipids surfactants are added and emulsified through high pressure homogenization .Purified through high temperature of steam.

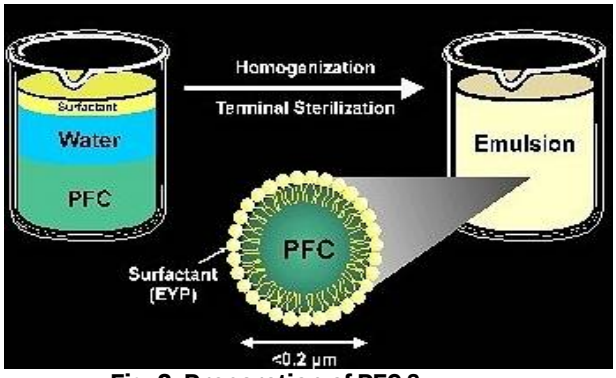

Fig. 2: Preparation of PFC S

EXAMPLES OF PFC'S

1. Perflurodecalin
2. Perflubron

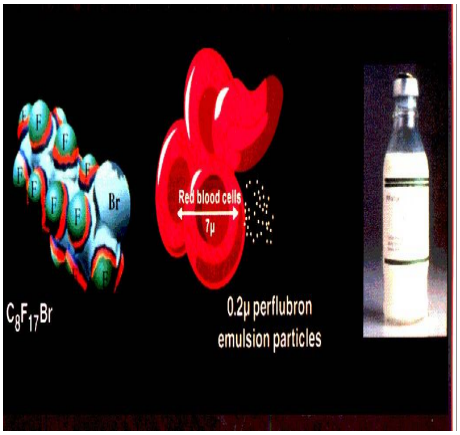

Fig. 3: Structure of perflubron emulsion

ADVANTAGES OF PFC'S

1. PFC s do not react with oxygen
2. PFC s allow easy transportation of the oxygen to the body
3. They allow increased solubility of oxygen in plasma.

DISADVANTAGES OF PFCS

1. Often causes flu like symptoms.
2. It decreases platelets count.

2. HAEMOGLOBIN BASED OXYGEN CARRIERS (HBOCS)

Haemoglobin based oxygen carriers were created as a mechanism to mimic the oxygen carrying role of haemoglobin in the body, while still reducing the need for real human haemoglobin.

A. Haemoglobin is a tetramer with 2-α and 2-β polypeptide chains, each are bound to an iron heme group which successively binds to oxygen molecule.
B. Haemoglobin'sheme bond allows, it to have a higher affinity for oxygen, thus having excellent source of blood substitute.

EXAMPLE OF HBOC'S

POLYHEME

1. It is created by extracting haemoglobin from red blood cells, and after being associated in to tetramers the haemoglobin is mixed into an electrolyte solution.
2. It has a shelf life of approximately 12 months and is compatible with all blood types.

ADVANTAGESOF HBOC'S

1. Available in much larger quantities.
2. Can be sterilized via Pasteurization.

DISADVANTAGES OF HBOC'S

1. Reduced circulation half life.
2. It releases free radicals into the body.

PROMISING TECHNIQUES

1). STEM CELLS

1. Recently, the scientific community has begun to explore the possibility of using stem cells as a means of producing an alternate source of transfusable blood. A study performed by Giarratana et al. describes a large-scale ex-vivo production of mature human blood cells using hematopoietic stem cells, and may represent the first significant steps in this direction. Moreover, the blood cells produced in culture possess the same haemoglobin content and morphology as do native red blood cells. The authors of the study also contend that the red blood cells they produced have a near-normal lifespan, when compared to native red blood cells—an important characteristic of which current haemoglobin-based blood substitutes are found to be deficient.
2. The major obstacle with this method of producing red blood cells is cost. Now, the complex three-step method of producing the cells would make a unit of these red blood cells too expensive. However, the study is the first of its kind to demonstrate the possibility of producing red blood cells which closely resemble native red blood cells on a large scale.

2). DENDRIMERS

Researchers at the Dendritech Corporation have begun research, aided by a 2 year, $750,000 grant from the US Army, into the use of dendrimers as substitute oxygen carriers. The precise nature of the research cannot be disclosed, as the company's patent application has not yet been approved. Researchers hope that dendrimer technology will be the first truly cost-efficient blood substitute.

3) BIODEGRADABLE MICELLES

To enhance circulation times, recombinant or polymerized haemoglobin can be encapsulated within micellar-forming amphiphilic block copolymers. These systems are typically between 30-100 nm in diameter. The hydrophobic core of the polymer micelle is able

to solubilize the similarly hydrophobic haemoglobin protein, while the water soluble corona (which is usually polyethylene glycol) provides a steric barrier to protein absorption, and provides protection from clearance by the reticuloendothelial system (RES).

4) PLACENTAL UMBILICAL CORD BLOOD

Cord blood collected aseptically from the placenta after the birth of a healthy baby can be used safely as a blood substitute. It has higher haemoglobin content and growth factors than normal blood from an adult, which has the potential to benefit patients in varying diseases.

CONCLUSION

Blood substituents are currently undergoing clinical trials to determine the efficacy for the patient use in case of Hypovolemic shock. Two different distinct classes of artificial blood have been developed they are Perflourocarbon emulsion and Hemoglobin based oxygen carriers. Due to their adverse effects they are in clinical trials once after crossing the Clinical trials and available in market it will allow treating the patients rapidly with anemia and during accidents with the ongoing shortage of Donor patients. With the Help of biotechnology, there will be More blood Substituent's which could replace the natural blood in animals

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