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ARTIFICIAL BLOOD - A game changer in Blood transfusion

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Abstract: -

Artificial blood is a production concept of transfusion medium where explicitly defined compounds play the role of transport and delivery of oxygen in the body to supplement this function of allogenic human blood transfusion. The normal human blood with artificial blood substitutes in the place of blood transfusion during surgeries organ transfusion depending on the type of artificial blood it can be produced in different ways using synthetic production, chemical isolation (or) recombinant biochemical technology artificial blood is projected to altogether affect the improvement of clinical consideration in the further times. It can supplement the current blood production for transfusion and make a steady inventory of protected & powerful substitutes. It is probably going to decrease the prerequisites of blood transfusions particularly during injury & medical procedure, also reducing the depending on banked donated blood

Introduction:

Artificial blood is a product made to act as a substitute for red blood cells [1] it is a life Saving substance that carries oxygen to the body when there is a shortage of red blood cells [2] while true blood serves many different functions artificial blood is designed for the sole purpose of transporting oxygen and Carbon dioxide throughout the body Artificial blood products were first introduced in the early 1600s, and the development and research are still continuing for the ideal substitute, By the different ways are synthetic production, Chemical isolation or recombinant biochemical technology .Blood substitute is manufactured it can be sterilized to destroy bacteria and viruses while blood transfusion

History:

- William Harvey discovered blood pathways in 1616, many people tried to use fluids such as beer, urine, milk and non- human animal blood as blood substitutes [3]
- A significant breakthrough in the development of artificial blood came in 1883 with the creation of Ringer's solution composed of sodium potassium and calcium salts [4]
- The first successful human blood transfusions were done 1667.[5]

- The first approved oxygen-carrying blood substitute was a perfluorocarbon- based product called Fluosol-DA-290 manufactured by green cross of Japan. It was approved by the food and drug Administration [FDA] in 1989 [3]
- Since 1978 when the first clinical trail of an HBOC Haemoglobin based oxygen carriers was conducted [2]
- In 1990's Haemoglobin based oxygen carriers called Haemopure was approved for phase - 3 trail. In December 2003 new Haemoglobin based oxygen therapeutic called Polyheme was introduced [2]

Why we have to choose an Artificial blood?

The question of why blood should to be answered as blood has now gained in value and has become one of the most sought-after sources. During surgery and other organ transfusions, Blood volume can be lost when blood is needed. In our country. The receptor level is much higher than that of donor when donating blood to a patient there is a risk of complications such as blood of the same group, and pathogen free blood &Blood should be tested for infectious diseases The normal blood transfusion method is recommended, but can't continuously meet the blood demand [5]

Characteristics: -

- Very safe to use
- They are compatible in the human body
- We carry oxygen and deliver when need
- It is free from pathogen and toxins that the immune system would provide
- Blood substituents, also used synthetic blood are available
- Now called oxygen carried
- This is because they can't mini many of the other blood function [6]

Current Status: -

Material such as perfluorocarbon emulsion and modified haemoglobin have been evaluated and have been clinically used as artificial red blood cells, but none of them have proved satisfactory in terms of function and safety haemoglobin vesicles [HBV] Are high concentration haemoglobins encapsulated in a phospholipid biloyce analogous to erythrocytes. Which are currently being studied I Japan & Are the safest and most promising for practical use. While successful use of haemoglobin from expired blood is suggested, recombinant haemoglobin will most likely be used in the future blood group substance, proteins other than haemoglobin &viruses (If present) Are completely removed from RBC during the haemoglobin purification process by heating & filtering Re-encapsulation by a studied lipid membrane ensures that the product in liquid form can be stored for 2 days at room temperature product stored for a long period of time. Thus, are generally considered to be the key benefits of the 7 artificial blood products [6]

Haemoglobin Synthesis: -

steps 1:-

- To obtain haemoglobin, a strain of E-coli bacteria that has the ability to produce human haemoglobin is used
- In the course of about three days the protein of E-coli is harvested and the bacteria destroyed
- To start this Fermentation, process the pure bacteria culture which is rich in nutrients are transferred to a testable for growth. this is called initial inoculation process which causes multiply of bacteria.
- When modulation is great enough, they are transferred to a seed tank [7]

Step 2:-

- A seed tank is a large stainless steel kettile that provides the ideal environment for the growing of bacteria
- This tank is filled with warm water, food, ammonia which are required for production of haemoglobin other growth factors such as vitamins, amino acids and minor nutrients are also added.
- The bacteria solution inside the tank is constantly bathed with compressed air and mixed to keep if moving
- When enough time has passed, the contents of the seed tank is pumped to the fermentation tank [7]

Step 3:-

- The fermentation tank is larger version of the seed tank.
- This fermentation tank also filled with media needed for the bacteria to grow and produce haemoglobin.
- PH control is vital for optimal growth, ammonia water is added to the tank as necessary, when enough haemoglobin has produced, the tank is omptied so isolation can begin [7]

Step 4:-

- Isolation begins with a centrifugal separator that isolates much of the haemoglobin. It can be further segregated and purified using fractional distillation.
- This standard column separation met hod is based on the principle of boiling a liquid to separate one are more components and utilizes vertical structures called friclonating columns from this column, the haemoglobin is transferred to a final processing tank. [7]

Step 5:-

- Here, it is mixed with water and other electrolytes to produce the artificial blood
- The artificial blood can then be pasteurized and put into an appropriate packing
- The quality of compounds should Checked regularly during the entire process.
- Particularly into step is we should check frequently made on the bacterial culture
- Also, physical and chemical properties of the finished product are checked such as PH, melting point, moisture content etc,
- This method of production has been shown to able to produce batches as large as 2,640 gal (10,000L). [7]

Applications

Patient clinical Applications: -

Blood substituents: -

⇒ Haemoglobin shock haemolage (war, steigery anaemia

⇒ Whole body rinse out acute drug intoxication acute hepatic failure

⇒ Local Ischemia; acute myocardial infection; evolving MI; cardiac failure; brain infection acute arterial thrombosis

⇒ General Ischemia; co intoxication

⇒ Adjuvant therapy: radiotherapy, chemotherapy

⇒ Perfusional protection of organs during surgery cardiopulmonary bypass

⇒ Preservation of donor organ

⇒ Durg carrier drug conjugated haemoglobin and perfluoro chemical

Non clinical Applications:-

⇒ Culture medium

⇒ Chemical examination, oxygen sensor standard solution for oxygen calibration

⇒ Bio reactor Paradoxical utilisation (of high oxygen affinity)

⇒ Oxygen absorbent

⇒ Oxygen pulse therapy for malignant tamour in combination with radiotherapy (or) chemotherapy [7]

Conclusion: -

The test & screening methods have made the blood supply of doners increasingly safer for Example, The risk of transfusion related HIV infection is now estimated at in 835,000 infection ranges from 1 in 300,000 to 1 in 600,000, compared to rail of in 103,000 become available. As the safety of the doner blood supply continue to improve, the benefits of blood substitutes over donated blood should be carefully considered, primarily as risk. However, the shortage of blood doner for transfusion continue to support the development of readily available

blood substitutes more importantly the vascular resistance time of blood substitutes must be increased the cost of these products must be competition, and the difficulty of obtaining & processing sufficient quantities of these compounds must be overcome [8]

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