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Blood Substitutes

About 14 million units of blood were used last year in the United States, and while donations are increasing 2-3% annually, the need for blood is increasing by 6-8%. In Africa about 10-15 million units of blood are transferred each year without testing for HIV or Hepatitis.

Research for blood substitutes began in the 1960's. Iron-rich hemoglobin compounds were used to carry oxygen to tissues but they caused kidney toxicity. The newer compounds caused vasoconstriction, constriction and collapsing of blood vessels and capillaries because hemoglobin scavenges NO (nitric oxide) from the linings of blood vessel walls which is necessary for the smooth operation of muscles. Research in the 1990s and 2000s has produced several blood substitutes, such as Biopure, Oxygent, and MP4.

There are a few major Advantages of Blood Substitutes over conventional blood. Probably the most important is the universal compatibility which allows the transfer of any blood type without tests. Also of great importance is knowing that the substitute is free of any disease, has a much greater shelf life, and very predictable outcomes.

Blood substitutes can be broken down into 2 major categories: volume expanders and Oxygen therapeutics. Volume expanders simply increase the blood volume and consist of 2 smaller categories, *Crystalloid-based* and *Colloid-based*. Oxygen therapeutics try to mimic human blood's ability to transmit oxygen and among these are hemopure and hemospan.

Hemopure is a Hemoglobin-based oxygen carrying solution (HBOC). It is made of chemically stabilized, cross-linked bovine (cow) hemoglobin situated in a salt solution. It has some of the major advantages of any blood substitute in that it has a much longer shelf life and is free of viruses. It has been approved in South Africa for use in adult surgery patients to treat acute anemia and eliminate, reduce or delay red blood cell transfusion. Hemopure is smaller in size (up to 1,000 times smaller than a typical red blood cell) and has less viscosity than human red blood cells. Helps by carrying more oxygen at a lower blood pressure than red blood cells.

Hemospan is a human hemoglobin-based product that is intended to serve as an alternative to red blood cell transfusions. It is specifically designed to the optimal molecular size, viscosity, oxygen affinity and diffusion potential to target oxygen delivery to tissues at risk of oxygen deprivation. The starting material for Hemospan is unmodified hemoglobin derived from human red blood cells. Hemospan is produced in powder form, and can be mixed into liquid form and transfused immediately. It combines human red blood cells with polyethylene glycol (PEG) to eliminate the toxicity associated with free hemoglobin. When PEG is attached to the surface of hemoglobin, a thin layer of water is formed around the protein. This surrounding water layer is essential for three reasons, it protects the hemoglobin from the immune system, increases the effective size of the molecule, and produces a viscosity similar to that of native red blood cells.

Sources.

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