

## **Artificial Blood: Polymerized Human Hemoglobin**

Zac Canders  
ELE 482: Biomedical Seminar III  
March 28 2005

### Blood Facts:

Blood carries out the critical functions of transporting oxygen and nutrients to our cells and getting rid of carbon dioxide and other waste products. In addition, it plays a vital role in our immune system and in maintaining a relatively constant body temperature. The four main components of blood are red cells, white cells, platelets, and plasma.

### Artificial Blood:

The early development of hemoglobin-based oxygen carriers (HBOCs) (artificial blood) was problematic. Early preparations of unmodified tetrameric hemoglobin were plagued by renal, hepatic, gastrointestinal, pancreatic, and cardiovascular toxicities and organ dysfunction.

Modern chemically modified hemoglobin-based oxygen carriers (HBOC) are free of red blood cell membrane remnants eliminating renal toxicity, and they do not possess ABO antigens which allows transfusion without knowledge of the respective blood group of a patient.

### Additional Advantages:

- Can compensate for intravascular volume deficits in hemorrhagic shock
- deliver oxygen to organs and tissues during nearly complete blood exchange
- Chemical modifications of HBOC are able to reduce the vasoconstrictive side-effect of HBOC
- Improves the diffusive oxygen transport at the microcirculatory site thus decreasing tissue damage in acute pancreatitis and the heart and brain after ischemia/reperfusion injury

### Northfield Laboratories:

Leader in developing an oxygen-carrying blood substitute for the treatment of urgent, large-volume blood loss in trauma and resultant surgical settings.

### Product:

PolyHeme is a solution of chemically modified human hemoglobin that requires no cross-matching and is compatible with all blood types. It has a shelf-life of over 12 months. Treatment of urgent, large volume blood loss in trauma and surgical settings, with a particular focus on settings where blood is not immediately available.

### Production:

Proprietary process of separation, filtration, chemical modification, purification and formulation. First, hemoglobin is extracted from red blood cells and filtered to remove impurities. This purified hemoglobin is then chemically modified and purified using a multi-step process to create a polymerized form of hemoglobin.

### Facts:

- Physicians have replaced up to 200 % of a patient's total blood volume with Polyheme without complication
- May sustain life at life-threatening RBC [Hb] by maintaining total hemoglobin in the absence of red cell transfusion
- Allows rapid, massive infusion
- Does not cause transfusion reactions
- Is universally compatible
- Supports life without red blood cells

Study: 171 patients in the hospital setting received rapid infusion of 1 to 20 units. The 30-day mortality was 25.0% (10/40 patients) compared with 64.5% (20/31 patients) in historical control patients at. Conclusion: PolyHeme increases survival at life-threatening RBC [Hb] by maintaining total [Hb] in the absence of red cell transfusion.

these RBC [Hb] levels

### Recent Information:

Phase III, randomized, controlled testing. designed to evaluate the safety and efficacy of polymerized human hemoglobin (Polyheme) when used to treat patients in hemorrhagic shock following traumatic injuries beginning in the pre-hospital setting.

- 720 patients will be enrolled in the trial
- Eligible patients will be randomized to receive either the standard of care (salt water) or PolyHeme
- Conducted under federal regulations that allow clinical research in emergency settings using an exception from the requirement for informed consent.



### Sources:

- <http://www.northfieldlabs.com>
- **Johnson JL, Moore EE, Gonzalez RJ, Fedel N, Partrick DA, Silliman CC.** Department of Surgery, Denver Health Medical Center, USA. jeff.johnson@dhha.org
- Trauma. 2001 Mar;50(3):449-55; discussion 456.
- Successful Use of a Polymerized Hemoglobin Blood Substitute in a Critically Anemic Jehovah's Witness. Allison, Genève; Southern - - - Medical Journal, 2004, vol. 97, issue 12, p 1257, ISSN 00384348 -Artificial oxygen carriers: cell-free hemoglobin solutions Anesthesiol Intensivmed Notfallmed Schmerzther. 2005 Jan;40(1):38-45
- Trauma (The Journal of trauma.) 2003 Jan; 54(1): 133-9; discussion 139-40. Johnson JL ; Moore EE ; Gonzalez RJ ; Fedel N ; Partrick DA ; Silliman CC
- J Am Coll Surg (Journal of the American College of Surgeons.) 2002 Oct; 195(4): 445-52; discussion 452-5. Gould SA ; Moore EE.