

# **Allogenic Blood Transfusion Alternatives**

Essay

Submitted for the Partial Fulfillment of  
Master Degree in Clinical Hematology

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2010

## **Acknowledgement**

**First of all thanks to *Allah* for giving me the power and strength to carry out this work.**

I would like to show my sincere gratitude to **Professor Dr. Suzan Kamal ٱٱEldeen Hussein**. Professor of Internal Medicine and Hematology. Faculty Of medicine - Ain Shams University for giving me the privilege of working under her supervision.

In deed, words do fail me when I came to express my sincere appreciation to **Professor Dr. Essam Abdel Wahed Hassan**. Professor of Internal Medicine and Hematology. Faculty Of medicine - Ain Shams University, for his keen supervision.

I am heartily thankful to **Doctor Nermeen Adel Nabih**. Lecturer of Internal Medicine and Hematology. Faculty of medicine - Ain Shams University for her considerable help and continuous guidance.

*Finally, I would like to thank my family and colleagues for their support.*

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## **List of Abbreviations**

**2, 3-DPG:** 2, 3 diphosphoglycerate  
**AABB:** American Association of Blood Banks  
**AABT:** Alternative to Allogenic Blood Transfusion  
**ABT:** Allogenic Blood Transfusion  
**ACD:** acid citrate dextrose  
**ADs:** Adverse drug events  
**AHH:** Acute hypervolemic hemodilution  
**AHTR:** Acute hemolytic transfusion reaction  
**ALI:** Acute lung injury  
**ANH:** Acute normovolemic hemodilution  
**ATR:** Acute transfusion reaction  
**A-PTT:** Activated partial thrombo-plastin time  
**BM-MSCs:** Bone marrow derived mesenchymal stem cells  
**BFU-E:** Burst-forming units erythroid  
**BNP:** B-type natriuretic peptide  
**BT:** Bleeding time  
**CB:** Cord blood  
**CIA:** Chemotherapy induced anemia  
**CRASH-2:** Clinical Randomization of Antifibrinolytic in Significant Haemorrhage  
**cRBC:** cultured RBC'  
**CPB:** cardiopulmonary bypass  
**CB-MSCs:** Cord blood derived mesenchymal stem cells  
**CRF:** Chronic Renal Failure  
**CKD:** Chronic Kidney Disease  
**CRP:** C reactive protein  
**CFU-E:** Colony forming units erythroid  
**COP:** colloid osmotic pressure  
**DCLHb:** Diaspirin cross-linked hemoglobin  
**DDAVP:** 1-deamino-8-D-arginine vasopressin (Desmopressin)  
**DIC:** Disseminated intravascular coagulopathy  
**DHTR:** Delayed hemolytic transfusion reaction  
**EPO:** Erythropoietin  
**EpoR:** erythropoietin receptor  
**ESA:** erythropoiesis – stimulating agent  
**ESICIM:** European Society of Intensive Care Medicine  
**EACA:** Epsilon-amino caproic acid  
**FDA:** Food and Drug Administration  
**FFP:** Fresh frozen plasma  
**FID:** functional iron deficiency  
**FY:** Fiscal Years



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**Hb:** Hemoglobin  
**HBOCs:** Hemoglobin-Based Oxygen Carriers  
**HCV:** Hepatitis C Virus  
**HESCs:** Human embryonic stem cells  
**HF:** Hip fracture  
**HIV:** Human Immunodeficiency Virus  
**HTR:** hemolytic transfusion reaction  
**HLA:** Human leukocytic antigen  
**HPA:** human platelet antigen  
**HES:** hydroxyethyl starch  
**IBCT:** incorrect blood component transfused  
**ICS:** Intraoperative cell salvage  
**IgA:** Immunoglobulin A  
**IPM:** Infusible platelet membranes  
**LOS:** Length of hospital stay  
**LSCS:** lower segment cesarean section  
**MHC:** Histocompatibility complex  
**MOF:** Multiple organ failure  
**MSCs:** Mesenchymal stem cells  
**MW:** Molecular weight  
**NAT:** Nucleic Acid Amplification Testing  
**NESP:** Novel erythropoiesis-stimulating protein  
**NO:** Nitric oxide  
**OLT:** Orthotopic liver transplantation  
**PAD:** Preoperative Autologous donation  
**PABD:** Preoperative Autologous Blood Donation  
**PCS:** Postoperative cell salvage  
**PFCOCs:** Perfluorocarbon Oxygen Carriers  
**PFC:** Per fluorocarbon  
**PT:** Prothrombin time  
**PTP:** Post-transfusion purpura  
**Q3W:** Every three weeks  
**QOL:** Quality of life  
**RBCs:** Red Blood Cells  
**rFVIIa:** Recombinant activated factor VII  
**RCTs:** Randomised controlled trials  
**r-HuEpo:** Recombinant Human Erythropoietin  
**SABM:** Society for Advancement of Blood Management.  
**SHOT:** Serious Hazards of Transfusion  
**SNO-PEG-Hb:** S-nitrosylated pegylated hemoglobin  
**SIRS:** Systemic inflammatory response syndrome  
**SSI:** Surgical Site Infection  
**STfR:** soluble transferrin receptor

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**TA:** Tranexamic acid  
**TACO:** Transfusion Associated Circulatory Overload  
**TA-GVHD:** Transfusion-associated graft-versus host disease  
**TAS:** transfusion-associated sepsis  
**TF:** Tissue factor  
**THR:** Total hip replacement  
**TJA:** Total joint arthroplasty  
**TKA:** Total knee arthroplasty  
**T-PA:** Tissue plasminogen activator  
**TRALI:** Transfusion Related Acute Lung Injury  
**TRIM:** Transfusion Related Immuno-modulation  
**TTI:** transfusion-transmitted infection  
**UGI:** Upper Gastro Intestinal  
**VWD:** Von Willebrand disease  
**VWF:** Von Willebrand factor  
**WHO:** World Health Organization  
**WNV:** West Nile Virus

## INTRODUCTION

Blood transfusion undoubtedly saves life in treating hemorrhage that cannot be managed through cell salvage, and supports patients with bone marrow failure. However, blood transfusion is not without risk or cost and should only be used when there are no alternative approaches and there is a clear clinical indication. This principle has never been more necessary, given the current concerns and emerging evidence of the risks of Transfusion-associated variant Creutzfeldt-Jakob disease (vCJD). The transmission of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) by blood transfusion in the 1980s and 1990s led to the blood supply being subjected to an intense level of public, political and legal scrutiny. (*Knowles 2007*)

Allogeneic red blood cell transfusion is associated with well-known adverse effects .Infectious risks include possible viral, bacterial, parasitic or prion transmission. Non infectious risks, which include febrile, allergic/anaphylactic and hemolytic transfusion reactions, transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO), are more common than infectious risks and lead to greater morbidity and mortality. (*Kleinman et al 2003*)

Malaria, parvovirus B19, and cytomegalovirus are still major infectious problems from blood transfusion, although the extent is not well documented globally. These infections are not routinely screened for in all donations. While there remains a small risk of undetected window period infections from HIV and hepatitis C in developed countries. (*Murphy 2002*)

Many observational studies and a randomized clinical trial involving critically ill patients have shown an association between blood transfusions and increased risk of infection, prolonged mechanical ventilation, multiple-organ dysfunction and death. (*Tinmouth et al 2008*)

Allogeneic red blood cell transfusion is an independent risk factor for the development of acute respiratory distress syndrome (ARDS) in the intensive care unit population. The association of allogeneic blood exposure and ARDS development follows a dose-response relationship. (*Zilberberg et al 2007*)

There is considerable evidence that blood transfusions cause a generalized suppression of immune function in humans and experimental animals. (**Tartter 1992**)

Many studies have described a correlation between perioperative blood transfusions and postoperative infections, suggesting that blood transfusion interferes with the immune system of the recipient; thus transfusion-related immunomodulation may have an impact on host defense and on the clinical course of patients who received blood components. (**Rovera et al 2006**)

We found a statistically significant association between a history of blood transfusion and risk of non-Hodgkin lymphoma (NHL) and chronic lymphocytic leukemia (CLL). The risk was strongest for nodal disease and low-grade disease (**Cerhan et al 2001**)

We confirmed an association between blood transfusion and risk of non-Hodgkin lymphoma (NHL), and have identified multiple surgical procedures and anesthesia as additional risk factors, which have not previously been reported. The incidence of NHL has increased dramatically since at least the 1950s, and during this timeframe there has been a major increase in the use of blood transfusions, invasive surgical procedures and anesthesia, all of which can impact immune function. (**Cerhan et al 2008**)

Although anemia is associated with an increased risk of mortality, particularly in cardiovascular disease patients, allogeneic blood transfusion does not appear to improve short-term survival or to decrease in-hospital morbidity. These observations suggest that “10 g/dL native hemoglobin” is probably not the same as “10 g/dL transfused hemoglobin.” Therefore, preventive measures to limit the development of anemia should be encouraged (**Van der Linden 2002**)

A restrictive strategy of red-cell transfusion is at least as effective as and possibly superior to a liberal transfusion strategy in critically ill patients, with the possible exception of patients with acute myocardial infarction and unstable angina. (**Hebert et al 1999**)

Many reports of patients treated without transfusion for a variety of medical and surgical problems show that avoidance of allogeneic blood is safe and effective. Strategies for managing acute, severe anemia continue to evolve, as the critical limits for tissue oxygenation remain poorly defined. (**Goodnough 2007**)

**Blood management:** is the philosophy to improve patient outcomes by integrating all available techniques to reduce or eliminate allogeneic blood transfusions. It is a patient-centered, multidisciplinary, multimodal, planned approach to patient care. **(Seeber and Shander 2007)**

An alternative to allogeneic transfusion (AABT) might be defined as *any measure that contributes to reducing transfusion requirements and, consequently, the need for ABT*. The expert panel classified AABT into two groups: pharmacological AABTs and non- pharmacological AABTs. In order to attain a more functional classification of AABTs, they were further subdivided into four modules and 12 topics.

Module I. Pharmacological alternatives to reduce blood loss

1. Recombinant activated factor VII
2. Aprotinin
3. Tranexamic acid and epsilon-aminocaproic acid
4. Desmopressin

Module II. Pharmacological alternatives to stimulate erythropoiesis

5. Iron
6. Recombinant human erythropoietin

Module III. Pharmacological alternatives to increase oxygen transport

7. Crystalloids and colloids
8. Per fluorocarbon-based oxygen carriers
9. Hemoglobin-based oxygen carriers

Module IV. Nonpharmacological alternatives: autologous blood

10. Preoperative autologous blood donation
11. Perioperative cell salvage
12. Acute normovolemic hemodilution

**(Leal -Noval et al 2006)**

It is clear that, providing circulating volume is maintained, principally with infusions of crystalloids, blood transfusion can safely be reserved for treatment of life-threatening anemia rather than hemorrhagic shock and the patient outcome can be optimized. **(Fenton 2007)**

HBOC-201 eliminated the need for transfusion in the majority of patients. Patients < 80 years of age with moderate clinical needs safely avoided transfusions when treated with up to 10 units of HBOC-201. The intent-to-treat analysis was unfavorable with the crossover group (HBOC-201 to PRBC) being identified as the primary basis for the difference. The analytical methodology used identified that the crossover patients had a greater need for an oxygen carrier, likely related to patient age, volume overload and under-treatment. **(Jahr et al 2008)**

## AIM OF THE WORK

In our essay we are going to put spotlights on the concept of blood management, considering the recent risks and costs of allogenic blood transfusion and highlighting the new strategies that contribute to reduce or eliminate the need for allogenic blood transfusion, discussing allogenic blood transfusion alternatives, their types, indications, dosage and adverse effects

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