

# **UPDATES ON OPTIMAL TRANSFUSION THERAPY**

*Essay*

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Anesthesiology*

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***John Emil Riad***



# الأحدث عن النقل المثالي للدم

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## List of Abbreviations

|               |                                                    |
|---------------|----------------------------------------------------|
| <b>AABB</b>   | : American Association of Blood Banks              |
| <b>ADP</b>    | : Adenosine Diphosphate                            |
| <b>APC</b>    | : Activated Protein C                              |
| <b>aPTT</b>   | : activated partial thromboplastin time            |
| <b>ATP</b>    | : Adenosine Triphosphate                           |
| <b>bFGF</b>   | : Basic fibroblast growth factor                   |
| <b>BPG</b>    | : Bisphosphoglycerate                              |
| <b>CMV</b>    | : Cytomegalovirus                                  |
| <b>EDTA</b>   | : Ethylenediaminetetraacetic acid                  |
| <b>ENA</b>    | : Extractable Nuclear Antigen                      |
| <b>FDA</b>    | : Food and Drug Administration                     |
| <b>FDP</b>    | : Fibrinogen Degradation Product                   |
| <b>FNHTR</b>  | : Febrile Non Hemolytic Transfusion Reaction       |
| <b>GM-CSF</b> | : Granulocyte Macrophage Colony Stimulating Factor |
| <b>GP</b>     | : Glycerate 3-phosphate                            |
| <b>HbA1c</b>  | : Hemoglobin A1c                                   |
| <b>HBOC</b>   | : Hemoglobin-based oxygen carriers                 |
| <b>HBP</b>    | : Hyperbranched polymer                            |
| <b>Hct</b>    | : Hematocrit                                       |
| <b>HIV</b>    | : Human Immunodeficiency Virus                     |
| <b>HLA</b>    | : Human leukocyte antigen                          |
| <b>HPA</b>    | : Human platelet antigens                          |

## List of Abbreviations

|                   |                                               |
|-------------------|-----------------------------------------------|
| <b>HSC</b>        | : Hematopoietic Stem Cell                     |
| <b>HTD</b>        | : Hard to Treat Diseases                      |
| <b>HTLV</b>       | : <b>human T-cell lymphotropic virus</b>      |
| <b>IGF</b>        | : Insulin Growth Factor                       |
| <b>IIT Madras</b> | : Indian Institute of Teechnology at Madras   |
| <b>IL</b>         | : Interleukin                                 |
| <b>INR</b>        | : International Normalized Ratio              |
| <b>LEH</b>        | : Liposome-encapsulated hemoglobin            |
| <b>MCD</b>        | : Mean Corpuscular Diameter                   |
| <b>MCH</b>        | : Mean Corpuscular Hemoglobin                 |
| <b>MCHC</b>       | : Mean Corpuscular Hemoglobin Concentration   |
| <b>MCV</b>        | : Mean Corpuscular Volume                     |
| <b>MIP</b>        | : Macrophage Inflammatory Protein             |
| <b>NADH</b>       | : Dihydronicotiamide Adenine Dinucleotide     |
| <b>PAI</b>        | : Plasminogen activator inhibitor             |
| <b>PAR</b>        | : Protease Activated Receptor                 |
| <b>PDGF</b>       | : Platelet Derived Growth Factor              |
| <b>PECAM</b>      | : Platelet endothelial cell adhesion molecule |
| <b>PEG</b>        | : polyethylene glycol                         |
| <b>PF</b>         | : Platelet Factor                             |
| <b>PFBOC</b>      | : Perfluorocarbon-based oxygen carriers       |
| <b>PT</b>         | : Prothrombin Time                            |

## List of Abbreviations

|                 |                                                            |
|-----------------|------------------------------------------------------------|
| <b>RANTES</b>   | : Regulated on Activation, Normal T Expressed and Secreted |
| <b>RBC</b>      | : Red Blood Cell                                           |
| <b>Rh</b>       | : Rhesus                                                   |
| <b>SCF</b>      | : Stem cell Factor                                         |
| <b>SOD</b>      | : <b>Super Oxide Dismutase</b>                             |
| <b>t- PA</b>    | : Tissue type Plasminogen Activator                        |
| <b>TA- GVHD</b> | : Transfusion-Associated Graft Versus Host Disease         |
| <b>TGF</b>      | : Tissue Growth Factor                                     |
| <b>TRALI</b>    | : Transfusion Related Acute Lung Injury                    |
| <b>TRICC</b>    | : Transfusion requirements in critical care                |
| <b>u- PA</b>    | : urokinase type Plasminogen Activator                     |
| <b>VEGF</b>     | : Vasoactive Endothelial Growth Factor                     |
| <b>vWF</b>      | : Von Willebrand Factor                                    |
| <b>WBC</b>      | : White Blood Cell                                         |

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## **INTRODUCTION**

Blood transfusion is a life saving intervention. Every second, in every country of the world, someone needs blood. Surgery, trauma, severe anemia and complications of pregnancy are among the clinical conditions that demand blood transfusion. Whatever the degree of development of a health care system, transfusion is the only option for survival of many patients (*Malar, 2013*).

From donor to recipient, raw blood will undergo a succession of processing events before eventually becoming a qualified, recipient-adapted finished product (*Beauplet, 2001*).

Shortages may arise from a fall in supply, a lack of national blood transfusion services, policies, appropriate infrastructure, trained personnel, or financial resources to support the running of a voluntary non remunerated donor transfusion service. There is an urgent need to develop innovative ways to recruit and retain voluntary low-risk blood donors (*Osaro and Charles, 2011*).

Blood banks screen donors for risk factors and test donated blood to reduce the risk of transfusion-related infections, but they occasionally still occur. Blood is a port of transmitting hepatitis B, hepatitis C, HIV, syphilis, malaria (*Sharma and Tyler, 2011*).

Unnecessary blood transfusion when the availability of simpler, less expensive strategies that could provide equal or greater benefit not only does expose patients needlessly to the risk of potentially fatal transfusion reactions and infections, it also worsens the gap between supply and demand and contributes to shortages of blood and blood products for patients who are really in need (*Osaro and Charles, 2011*).

These strategies should include the correction of anemia using pharmacological measures as the use of antifibrinolytics to prevent bleeding and the use of erythropoietin and oral and intravenous iron and use of nonpharmacologic measures as preoperative autologous blood transfusion, perioperative red blood cell salvage and normothermia (*Osaro and Charles, 2011*).

The demand for more blood substitutes began during the Vietnam War as wounded soldiers were unable to be treated at hospitals due to blood shortage. These worldwide blood shortages have led scientists to synthesize and test what is called "Artificial blood" to bridge the gap between demand and supply (*Sarkar, 2008*).

These efforts have essentially focused on the ability of red blood cells to carry oxygen. Hence, most of the products that are in advanced-phase clinical trials are derivatives of hemoglobin and are known as hemoglobin-based oxygen carriers. However, to date, no oxygen-carrying blood

substitutes are approved for use by the US Food and Drug Administration (***Grethlein, 2012***).

Hopefully, as better blood substitutes are developed and enter routine clinical use, the need for blood transfusions in the operative and trauma settings will decrease. Large-scale production of blood substitutes would also help to meet the anticipated increase in demand for blood as the population increases and the blood donor pool diminishes.

## **AIM OF THE ESSAY**

The goal of this work is to focus on blood and blood products as regard preparation, storage, indications for transfusion, complications and methods to avoid such complications by optimal use of each product. Also, the recent solution "Oxygen carrying blood substitutes" or what is called "Artificial blood" as a new method to overcome many of these complications.