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 ÓÓEldeen 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
ADEs: 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

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 Autologus 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

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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