

CONTENTS

Preface **xiii**
Howard L. Corwin and Paul C. Hébert

Anemia in the Critically Ill **159**
Aryeh Shander

Anemia is present in a substantial number of patients with a variety of chronic and serious diseases, including chronic kidney disease, cancer, diabetes, cardiovascular disease, HIV/AIDS, rheumatoid arthritis, and inflammatory bowel disease. Anemia is the primary cause of red blood cell transfusions. Anemia can be both acute (eg, hemorrhage) and chronic (eg, anemia of chronic disease), and it is especially prevalent and even expected in critical care settings. This article describes the underlying physiology of anemia and the various ways by which red blood cell production can be affected by ongoing disease processes.

Blood Transfusion Practice Today **179**
Nicholas S. Ward and Mitchell M. Levy

In the last several years, many important studies have been published that not only cast doubt on the benefits of packed red blood cell (PRBC) transfusion but also have sought to redefine the optimal threshold value of hemoglobin concentration that warrants transfusion. Recently, there have been two large descriptive studies that sought to describe the current practice of PRBC transfusion in ICUs and correlate that information with clinical outcomes. This article reviews these studies of current transfusion practices and tries to use this information as a guide to effective transfusion practice.

Physiologic Aspects of Anemia

187

Paul C. Hébert, Phillipe Van der Linden, George Biro,
and Ling Qun Hu

This article describes some of the basic principles of oxygen transport that have been studied extensively and published in text books and review articles. It emphasizes the physiological consequences of anemia to provide information relevant to red cell transfusion decisions.

Tissue Oxygen Delivery and the Microcirculation

213

Hiroshi Morisaki and William J. Sibbald

This article describes the function of the microcirculation initially during health and then in critical illness. The goal is to provide insight as to how this level of the circulation functions when challenged by sudden depressions in oxygen (O_2) delivery following abnormalities in other levels of the circulation (ie, shock associated with myocardial infarction) or in arterial O_2 content (ie, acute hypoxia or acute anemia). The article briefly touches on the function of the central and regional levels of the circulation in critical illness, because their performance is important to the ultimate stress imposed on the microcirculation's capacity to maintain tissue O_2 availability.

Clinical Consequences of Anemia and Red Cell Transfusion in the Critically Ill

225

Paul C. Hébert, Bernard J. McDonald, and Alan Tinmouth

Transfusion of packed red cells, a complex biologic product prepared from donated blood, is unique in many respects when compared with other health interventions. Decisions concerning the use of allogeneic red blood cell (RBC) transfusion in the treatment of anemia and hemorrhage require a clear understanding of both the risks and benefits of both the condition and its treatment. Although we have developed a much clearer appreciation for the infectious and immunomodulatory risks of RBC transfusion over the past 2 decades, the risks of anemia in many clinical settings and the benefits of RBC transfusion are still inadequately characterized. We presume that the most significant risk associated with anemia is the harm resulting from the decrease in oxygen carrying capacity and plasma volume. The development of adverse health consequences from anemia will, in part, depend on the capacity of the individual patient to compensate for these changes. The benefit of transfusion refers to the capacity of RBCs to correct these risks and possibly provide additional benefits such as increasing oxygen delivery to supranormal ranges. Such a framework highlights the concept that the tradeoffs of risks and benefits may not be equivalent. With the exception of patients who refuse blood for religious reasons, it is impossible to clearly distinguish between these competing risk and benefits outside a randomized clinical trial.

Blood Transfusion Risks in the Intensive Care Unit

237

Mercy Kuriyan and Jeffrey L. Carson

This article reviews transfusion risks with particular emphasis on the critically ill. It describes the various types of noninfectious, infectious, and mild-to-severe reactions that can occur in a transfused patient. The article describes differential diagnosis of these reactions and the handling and treatment of the patient. Diagnosis of the type of transfusion reaction by laboratory tests is detailed. Finally, the article discusses the dangers of human error with possible strategies to combat this problem using new technologies.

Efficacy of Red Blood Cell Transfusion in the Critically Ill

255

Lena M. Napolitano and Howard L. Corwin

Red blood cell (RBC) transfusions are used commonly in the critical care setting in an attempt to increase oxygen delivery to the tissues and in turn improve tissue oxygenation, especially in shock states. The rationale for this therapeutic approach is that an increase in hemoglobin will increase the oxygen carrying capacity of blood and thus provide more oxygen delivery to delivery-dependent tissue. Stored RBCs, however, have a low p50 that increases the affinity of hemoglobin for oxygen and thereby reduces oxygen release to tissues. Furthermore, standard CPD-stored blood is depleted of 2,3 diphosphoglycerate (2,3 DPG) and ATP rapidly, with resultant inadequacy of the red cell oxygen transport function. Studies regarding the efficacy of RBC transfusions to increase tissue oxygen consumption and to improve microcirculation have yielded conflicting results. This article critically reviews the efficacy of RBC transfusions in the critically ill.

Transfusion in the Cardiac Patient

269

Donat R. Spahn, Nadia Dettori, Roman Kocian,
and Pierre-Guy Chassot

Allogeneic blood transfusions are associated with adverse effects and high costs. Additionally, they may increase morbidity and mortality of patients treated in intensive care units (ICUs). In contrast, blood transfusions may decrease mortality in elderly patients with acute myocardial infarction, and a low hematocrit during cardiopulmonary bypass has been associated with an increased post-operative morbidity and mortality. Correcting a low hematocrit during cardiopulmonary bypass by allogeneic blood transfusions, however, has increased mortality. This article reviews the evidence about when to transfuse and when not to transfuse in patients with a coexisting cardiac disease undergoing surgery or being treated in an ICU.

Transfusion in Surgery and Trauma

281

Carl I. Schulman and Stephen M. Cohn

The role of transfusion in surgery and trauma continues to evolve with our greater understanding of the true indications for and effects of transfusion. The potential adverse immune consequences and end-organ effects of blood transfusion must be weighed against the need for replacement of blood volume and oxygen-carrying capacity. The techniques to conserve blood and avoid transfusion play an important role in caring for the bleeding surgical patient. The future holds great promise for the possibility of redefining the art of blood transfusion and perhaps one day replacing it entirely.

Transfusion in Pediatrics

299

Lars Desmet and Jacques Lacroix

The results of studies done in adults cannot be generalized to the pediatric population, because many host and disease characteristics are specific to neonates, infants, and children. This article highlights the differences between children and adults with respect to red blood cell (RBC) transfusion. It also reviews the evidence on RBC transfusion effectiveness and usefulness among children who require a stay in a pediatric intensive care unit. There is a striking variation in stated and observed practice patterns of red blood cell transfusion among pediatric critical care practitioners. The lowest hemoglobin level that can be considered as a safe and useful threshold for RBC transfusion is unknown, and there is almost no evidence on the risks and benefits of transfusion to critically ill children. Further clinical studies are needed to improve the clinical practice of pediatric intensive care specialists with respect to RBC transfusion.

Blood Conservation for Critically Ill Patients

313

Robert A. Fowler, Sandro B. Rizoli, Phillip D. Levin,
and Terry Smith

Anemia may be the most common illness of critically ill patients. The majority of critically ill patients are anemic at admission to the intensive care unit (ICU), and hemoglobin concentrations typically decline during the first 3 days of ICU stay. Hemoglobin continues to decline for patients with sepsis and higher severity of illness. This patient population may be at particular risk of adverse consequences of anemia given the cardiovascular, respiratory, and metabolic compromise frequently encountered during critical illness. The etiology of anemia of critical illness is multifactorial, resulting from phlebotomy, gastrointestinal bleeding, coagulation disorders, blood loss from vascular procedures, renal failure, nutritional deficiencies, bone marrow suppression, and impaired erythropoietin response.

Index

325