Chapter 20
Hematology and Transfusion

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ABSTRACT

The cardiac perioperative period presents a unique clinical scenario where the risk of life-threatening hemorrhage is balanced against the risk of thrombosis. Management practices are in a continual flux as practitioners respond to evidence showing the serious harms independently associated with anemia, bleeding and transfusion of blood (Ranucci, Aronson, et al., 2011a). Despite comprehensive transfusion guideline recommendations rates of blood transfusion range from 7.8% to 92.8% across US hospitals (Bennett-Guerrero et al., 2010). In this chapter we navigate the complex hemostasis and transfusion issues in cardiac surgery to provide clinicians a comprehensive understanding of the coagulation system in this specialized population. We emphasize a multidisciplinary team approach focused on risk stratification with preoperative optimization to minimize coagulopathy and bleeding followed by a tailored and conservative use of blood products for maximum patient benefit.

INTRODUCTION

Cardiac surgery is associated with a high potential for life-threatening bleeding. The propensity to bleed is multifactorial and dependent on the combined effects of the surgical intervention, the application of antithrombotic and antiplatelet therapies as part of the medical management for cardiovascular disease plus the resultant hemodilution and associated coagulopathy predictably following CPB. While most cardiac patients tolerate the coagulation alteration secondary to implementation of CPB, up to half will receive a blood transfusion totaling up to 2.5 million blood transfusions a year (Speiss, 2002). When life-threatening bleeding occurs, timely blood product administration supports the hemodynamics, reverses coagulopathy and treats anemia to restore hemoglobin and ensure adequate delivery of oxygen

to tissues. Multiple studies have demonstrated the negative consequences of anemia in cardiac surgery patients including increased renal failure, strokes and mortality (Carson et al., 2011; Loor et al., 2012; van Straten et al., 2009).

In the non-bleeding cardiac surgery patient with anemia no data supports a universally applicable hemoglobin level at which to transfuse and our ability to measure oxygen levels at organs is scarce. The transfusion of blood in anemic patients should help in oxygen delivery to tissues but there is evidence that transfused blood fails to increase tissue oxygen utilization (Suttner et al., 2004). In addition, the potential infectious, inflammatory and immunomodulatory effects of blood transfusion cannot be underestimated. The evidence for worsened outcomes after transfusion of even a single unit of blood in cardiac surgical patients continues to grow and includes increased risk of infection, sepsis, renal failure, prolonged mechanical ventilation and mortality (Koch et al., 2006; Murphy et al., 2007; van Straten et al., 2009). With a greater concern for the risks of transfusion, tolerance of anemia emerged and several randomized control trials were performed comparing liberal and restrictive transfusion strategies in a variety of clinical settings showing no mortality benefit with a higher hemoglobin (Carson et al., 2011; Hajjar et al., 2010; Hébert et al., 1999; Villanueva et al., 2013)

The true relative risk of allogenic blood transfusion versus anemia is unknown and there is marked variation in transfusion practices across hospitals. Evaluating the cardiac patients receiving transfusions has identified that 80% of blood products are being used in only 10-20% of all patients (V. A. Ferraris & Ferraris, 1995). Risk factors for blood transfusion after cardiac surgery include emergency surgery, low preoperative hematocrit, older age, female sex, length of cardiopulmonary bypass time, complexity of surgery, poor left ventricular function, insulin dependent diabetes and renal insufficiency (Despotis et al., 1996; V. A. Ferraris et al., 2011). Identifying modifiable risk factors while developing tools and techniques to optimize patients pre-operatively combined with coagulopathy prevention to minimize bleeding and reliance on transfusion as treatment for anemia forms the basis of effective Patient Blood Management (PBM) protocols. Curtailing bleeding and transfusion involves timely cessation of pre-operative anticoagulation medications, special considerations with hemodilution on CPB, employing pharmacologic therapies directed at minimizing fibrinolysis, implementing goal directed hemostatic therapy practices using alternatives to traditional blood components for coagulopathy reversal and prioritizing leukoreduced and newer blood products to diminish inflammatory or immunomodulatory effects. A multidisciplinary team should be responsible for the execution of the Patient Blood Management protocols as teams, not individuals, care for cardiac patients in the Operating Room (OR) and the Intensive Care Unit (ICU).

Chapter Objectives:

- Define and review the coagulation abnormalities present in the post-cardiac surgery patient
- Review the pharmacologic management of coagulopathy in the cardiac surgery patient
- Review the consequences of anemia, bleeding and blood transfusion in cardiac surgery patients
- Review strategies for the management of the bleeding cardiac surgery patient
- Define the rationale and indications for currently available blood and blood component therapy
- Review strategies for blood conservation in cardiac surgery
- Review future research and emerging trends in the hematologic issues affecting cardiac surgery patients

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