Transfusion-related Acute Lung Injury

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OBJECTIVES

Objectives of this lecture will be 1). To review recent data on the prevalence of transfusion-related acute lung injury (TRALI), 2). To examine proposed mechanisms for the development of TRALI and 3). To provide data on lung injury as it relates to red cell and component transfusion.

Transfusion-related acute lung injury (TRALI) is the most common cause of morbidity related to transfusion. Contemporary data from the Food and Drug Administration FY 2009 reports TRALI is the most frequent cause of transfusion-related mortality in the US. Blood components containing plasma have been implicated in TRALI with fresh frozen plasma (FFP), and red blood cell (RBC) units the most commonly implicated products. A recent publication noted that residual plasma in amounts as little as 10-20ml that contain donor derived white blood cell antibodies can cause TRALI.

Clinically TRALI is characterized by acute onset of respiratory distress, accompanied by hypoxemia, bilateral infiltrates on CXR, and presenting within 6 hours of transfusion. In addition, there should be no evidence of left atrial hypertension and a lack of temporal relationship to alternative risk factor for acute lung injury. Reports note that over 70% of patients may require mechanical ventilation to support oxygenation however a majority will have symptom resolution within 96 hours.

Two most commonly proposed mechanisms for the development of TRALI include the immune-mediated theory and the two-hit hypothesis. The immune-mediated theory proposes that TRALI develops as a result of a passive transfer of HLA or HNA antibodies from the donor product that react against the recipients leukocyte antigen resulting in activation of the recipient leukocytes, with release of cytotoxic contents and subsequent pulmonary microvascular lung injury. Approximately, 60-90% of reported TRALI cases have been attributed to the immune-mediated TRALI theory.

The second theory for development of TRALI is the two-hit model whereby a ‘first hit’ or inciting event, such as surgery or trauma, primes the patient’s neutrophils and activates the pulmonary endothelial cells leading to pulmonary sequestration of neutrophils. The ‘second hit’ occurs with transfusion of biologically active mediators present in the blood product. As a consequence of the ‘second hit’ the neutrophils become activated, releasing their cytotoxic contents with resultant pulmonary endothelial cell damage.

Women who have become pregnant frequently have HLA antibodies with prevalence estimates ranging from 27-30% for women who have had 3 or more pregnancies. (Prevalence of antibodies increase with increasing number of pregnancies). Elimination of female plasma donors has been implemented to mitigate the risk of TRALI. In the US approximately 95% of plasma is from male donors; for more rare blood types approximately 65% is from male only donors. As noted, the diagnosis of TRALI is primarily a clinical one and is particularly challenging in the surgical setting. Education and improved surveillance will allow for adequate diagnosis and more accurate prevalence estimates.

REFERENCES

17. FDA: Fatalities reported to the FDA following blood collection and transfusion. Annual Summary Fiscal Year 2009

