

BLOOD BULLETIN

JUNE 2013

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Transfusion-Associated Circulatory Overload

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Introduction: Transfusion-associated circulatory overload (TACO) is a frequent occurrence, complicating 1-8% of transfusions.^{1,2} TACO has emerged as a major cause of transfusion morbidity. It is also the second most common cause of transfusion-related death reported to the FDA, causing an average of about 15% of these deaths since 2007.³ TACO is hydrostatic pulmonary edema precipitated by transfusion. It is characterized by respiratory distress within six hours of transfusion. Both red blood cell (RBC) and plasma-containing blood components may trigger the reaction.

Recognition and Diagnosis: The most frequent presenting features are dyspnea (77%), hypertension (43%), and hypoxia (36%).⁴ Presenting signs and symptoms include acute dyspnea, orthopnea, cyanosis, tachycardia, widened pulse pressure, jugular venous distension, and increased pulmonary wedge pressure.⁵ Acute or worsening cardiomegaly and bilateral infiltrates are present on chest X-ray. The key supporting laboratory finding is elevated brain natriuretic peptide (BNP) or NT-Pro-BNP⁶, but these tests only have a positive predictive value of 74-78%⁷, and therefore are not diagnostic. There are no universally accepted diagnostic criteria, but three or more of the signs/symptoms described in the above table within six hours of transfusion fit the CDC's National Healthcare Safety Network criteria for TACO.⁹

Differential Diagnosis: TACO must be differentiated from transfusion-related acute lung injury (TRALI), with which it shares some features: hypoxemia, respiratory distress and pulmonary edema.⁸ However, TRALI is characterized by hypotension and low-grade fever without cardiomegaly, occurring most typically within one to two hours of transfusion. Pulmonary capillary wedge pressure (PCWP) is normal

or low. BNP may be elevated in TRALI. TACO and TRALI may occur in the same patient concurrently.

Signs, Symptoms, & Findings in TACO

The Following may occur during or within six hours of transfusion:

- Acute respiratory distress (dyspnea, orthopnea, cough);
- Evidence of positive fluid balance;
- Elevated brain natriuretic peptide;
- Radiographic evidence of pulmonary edema;
- Evidence of left heart failure;
- Elevated central venous pressure;

Epidemiology: There is clearly marked underreporting of TACO. In the surgical literature, 1-8% of transfused orthopedic joint replacement patients develop this complication.^{2,5} In passive hemovigilance systems, the reported rate is much lower but this most certainly represents under-reporting. In one study using passive reporting the prevalence rate was 1 in 1,566 patients, increasing to 4.8% after implementing active surveillance.¹⁰ Fresh frozen plasma was the most frequently implicated blood product, and most cases occurred in the intensive care unit (ICU). Most patients who develop TACO are 70 years of age or older, but 32% are 18-69 years, underscoring that TACO affects all age groups.⁴

Morbidity and Mortality: In many countries, TACO is either the first or second most common cause of death from transfusion. In the Quebec Hemovigilance System, it accounted for 86% of deaths.¹¹ The death rate from TACO in most studies is between 1-4%, but at one major medical center it was 8.3%.¹⁰ Morbidity is significant, as 21% of cases are

(continued on next page)

life-threatening with associated increases in lengths of ICU and hospital stay.^{5,12}

Pathogenesis and Risk Factors: The mechanism of TACO is an increase in pulmonary blood volume and capillary hydrostatic pressure with a diminution in lung compliance, resulting in pulmonary edema.⁵ Risk factors include 1) extreme age;¹² 2) left ventricular dysfunction;⁷ 3) renal disease; 4) history of congestive heart failure; 5) female gender; 6) recent vasopressors; and 7) positive fluid balance.¹³ Many patients with TACO show evidence of fluid overload prior to transfusion. The average RBC transfusion volume triggering TACO is 2.11 units, but a single transfusion is sufficient to trigger a reaction.¹⁴ Administration rate is also a factor. In one study of plasma-related TACO, the infusion rate varied from 300-900 mL/hour (one unit = 250mL); the mean infusion rate was > 2 units/hour.⁹ There is a correlation between the volume of blood product transfused and increased PCWP.¹⁵

Managing TACO: Stop the transfusion as soon as the signs and symptoms suggest TACO. Place the patient in a seated position, provide supplemental oxygen, and administer diuretics as indicated.⁵ Other measures for congestive heart failure may be taken if the patient does not respond.

Prevention: Clinicians must assess the patient for TACO risk before transfusion. This includes an assessment of intravascular volume and fluid balance, and a determination of cardiac, renal and respiratory function. For patients at high risk, as defined above, slowing the rate of transfusion to less than the current recommendation of 2-4 mL/minute, administration of pre-transfusion diuretics, and single unit transfusions are appropriate. When multiple units are transfused, an assessment of the patient's volume status should be performed between units. An essential safety step is nursing vigilance at the bedside, with frequent observations of vital signs and signs and symptoms of a transfusion reaction.

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