

Transfusion-Associated Circulatory Overload (TACO)

Transfusion-Associated Circulatory Overload (TACO) is a complication of acute dyspnea that occurs during or within 6 hours of transfusion.

TACO is caused by circulatory volume overload associated with blood transfusion. Prior to the transfusion, the patient's cardiac and/or renal function should be clinically assessed to determine the volume and rate of the transfusion to prevent TACO.

If TACO occurs, transfusion has to be stopped immediately and appropriate measures such as the administration of oxygen or diuretics, depending on the severity, have to be taken.

Pathophysiology

- TACO involves cardiac failure due to circulatory overload associated with transfusion, and is accompanied by dyspnea.
- Circulatory overload due to blood transfusion or excessive flow rate in critically ill patients with impaired cardiac, renal or pulmonary function may cause dyspnea.

Clinical presentation

- Symptoms of congestive heart failure are observed and chest X-rays indicate congestion.
- Dyspnea may occur and be accompanied by orthopnea, cyanosis, tachycardia, and increased blood pressure during or within several hours after transfusion.
- Rales and/or a third heart sound is heard on auscultation in patients with TACO. Neck-vein distention or lower limb edema may be observed.
- Elevated BNP or NT-proBNP* is supportive of a TACO diagnosis.

*BNP: brain natriuretic peptide

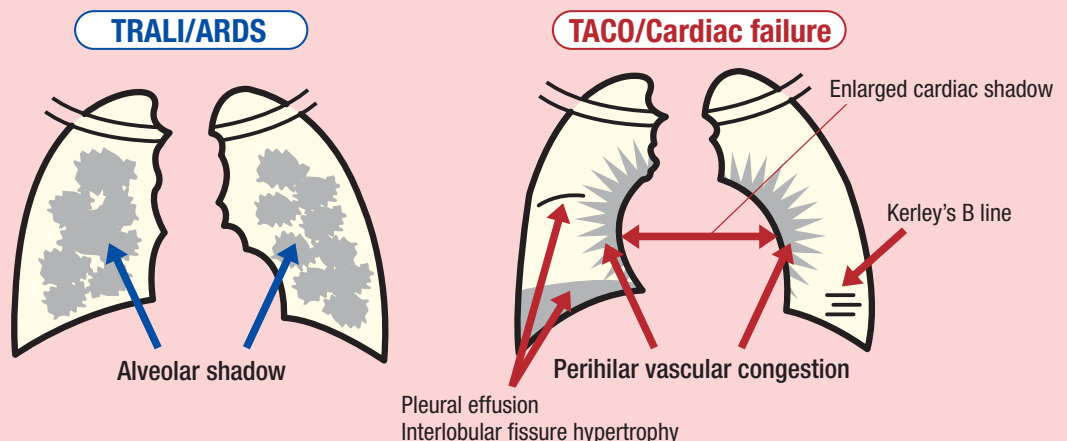
NT-proBNP: N-terminal pro-brain natriuretic peptide

Risk factors

- To perform transfusion of at-risk patients with any of the following factors of potential cardiac and/or renal failure, it is necessary to reduce the transfusion rate and volume, and to monitor the patients closely during transfusion.
 - (1) Cardiac dysfunction (cardiac toxicity of anticancer drugs, chronic anemia, etc.)
 - (2) Renal dysfunction
 - (3) Hypoalbuminemia
 - (4) Pretransfusion circulatory overload (excessive transfusion/fluid infusion)
 - (5) Elderly patients (especially 70 years and older)
 - (6) Patients with low body weight

Treatment

- Monitor patients closely. Stop the transfusion immediately when symptoms occur.
- Supplemental oxygen and/or diuretics administration should be considered as treatment of cardiac failure, according to the severity.¹⁾



Background

Post-transfusion dyspnea due to volume overload has been recognized as a complication of transfusion since the 1950s. The International Society of Blood Transfusion (ISBT) proposed a standard definition and evaluation/diagnostic criteria of adverse reactions to transfusion in the mid-2000s. The evaluation of TACO cases also started in Western countries according to these criteria. As TACO has become widely recognized, the number of TACO cases has been increasing year by year. In the United States, TACO was the second leading cause of transfusion-related deaths in 2014.²⁾ The number of reported cases in the United Kingdom has also been increasing.³⁾

TACO has been added to the section on adverse reactions of the national Guideline for transfusion therapy (revised version) (partially revised in March 2012). Therefore, the Japanese Red Cross Society revised the [PRECAUTIONS] in the package insert and added "Transfusion-Associated Circulatory Overload (TACO)" to the section of excessive transfusion (revised in April 2014).

The Japanese Red Cross Society started assessment of TACO cases in April 2012. There have been 99 cases of TACO in these three years.

TACO cases

Case 1 (cardiac toxicity of anticancer drugs)

Patient	Female, 60s, height: 151 cm, body weight: 43 kg
Primary disease	Breast Cancer and pancytopenia due to preoperative chemotherapy
Complications	None
Clinical course	<p>The patient visited the hospital with lightheadedness, dizziness and palpitations. WBC 500/μL, Hb 6.6 g/dL, PLT 103,000/μL. G-CSF was administered.</p> <p>18:00 BT 36.2°C, BP 190/120 mmHg, HR 110/min</p> <p>18:25 Transfusion of one bag of RBCs was initiated (transfusion rate: 2.5 mL/min).</p> <p>20:17 RBC transfusion was completed.</p> <p>21:00 The patient developed palpitations, dyspnea, cyanosis and peripheral coldness.</p> <p>21:10 Pulmonary murmur, moist rales and wheezing sounds were heard on auscultation.</p> <p>21:36 Blood gas values were pH 7.029, PaO₂ 63.6 mmHg, PaCO₂ 45.5 mmHg, SpO₂ 74.8% (O₂ 3 L/min, cannula), and Hb 11.4 g/dL.</p> <p>21:50 BT 37.0°C, BP 220/124 mmHg, HR 170/min. She was transferred to the emergency room and intubated for management by mechanical ventilation.</p> <p>22:45 Bilateral infiltrates and cardiomegaly were investigated on chest X-ray. BiPAP assist, FiO₂ 60% on mechanical ventilation, PEEP 20.0. She was transferred to the ICU.</p> <p>The next day -----</p> <p>6:00 BT 36.8°C, BP 116/66 mmHg, HR 96/min. Blood gas values were pH 7.232, PaO₂ 277.0 mmHg, PaCO₂ 48.6 mmHg, SpO₂ 99.0% (mechanical ventilation FiO₂ 50%).</p>

Comments

Transfusion of 2 units of RBCs over 2 hours is not considered excessive in terms of transfusion volume/rate. Taking into account that the patient had a CTR of 55% and LVEF of 25% before the onset of pulmonary edema, NT-proBNP of 51,900 pg/mL before transfusion and 67,400 pg/mL after transfusion, it is considered that anticancer drug-induced cardiotoxicity followed by transfusion caused pulmonary edema.

Case 2 (chronic anemia)

Patient	Female, 80s, height: 146 cm, body weight: 41.5 kg
Primary disease	Aplastic anemia
Complications	None
Clinical course	<p>Before transfusion: BT 36.4°C, BP 160/80 mmHg, HR 107/min, SpO₂ 96% (room air), Hb was 6.2 g/dL.</p> <p>16:50 One small bag of RBCs was transfused (transfusion rate: 2.3 mL/min).</p> <p>17:50 Another small bag of RBCs was additionally transfused. SpO₂ 95% (RA).</p> <p>18:50 One bag of RBCs was initiated. BT 37.0°C, BP 162/72 mmHg, HR 87/min. As SpO₂ had decreased to 88% (RA), administration of O₂ at 2 L/min was started through a mask.</p> <p>21:00 The patient developed dyspnea. BT 37.1°C, BP 192/90 mmHg, HR 120/min. Blood gas values were pH 6.984, PaO₂ 35.2 mmHg, PaCO₂ 80.5 mmHg, SpO₂ 40.5% (O₂ at 4 L/min through a mask). SpO₂ 65% (O₂ at 4 L/min through a mask). Mechanical ventilation with BiPAP was started. Moist rales were heard on auscultation.</p> <p>21:30 Blood gas values were pH 6.972, PaO₂ 62.5 mmHg, PaCO₂ 78.6 mmHg, SpO₂ 76.0% (mechanical ventilation: FiO₂ 100%). Bilateral infiltrates and congestion were investigated on chest X-ray. Intake and output: Transfusion 2 bags of RBCs, infusion fluid 500 mL, urine output of 1150 mL.</p> <p>The next day -----</p> <p>7:47 Blood gas values were pH 7.321, PaO₂ 183.8 mmHg, PaCO₂ 36.2 mmHg, SpO₂ 99.2% (mechanical ventilation: FiO₂ 100%) Hb was 9.2 g/dL after transfusion.</p>

Comments

Pre-transfusion chest X-ray showed an enlarged cardiac shadow. Pulmonary hilar edema and a significant Kerley's B line in the lower right lung, typical findings of cardiac failure, were investigated after transfusion. Two bags of RBCs were transfused to the elderly patient with chronic anemia, and Hb increased to 9.2 g/dL. However, the patient developed congestion and dyspnea.

[Reference]

- 1) Guidelines for Treatment of Acute Heart Failure 2011 Working Group, Guidelines for Treatment of Acute Heart Failure (2011 revised version) (http://www.j-circ.or.jp/guideline/pdf/JCS2011_izumi_h.pdf)
- 2) Fatalities Reported to FDA Following Blood Collection and Transfusion Annual Summary 2014 (<http://www.fda.gov/downloads/BiologicsBloodVaccines/SafetyAvailability/ReportaProblem/TransfusionDonationFatalities/UCM459461.pdf>)
- 3) SHOT Annual Reports and Summaries (<http://www.shotuk.org/shot-reports/>)

In case any of adverse reactions and/or infections related to transfusion of blood components, please notify the medical representatives of your local JRC blood center immediately. Please provide the residual products, the recipient's pre- and post-transfusion samples, and any other related materials; it is helpful to investigate and/or identify the cause. For storage of residual products and the recipient's samples, refer to the "Guidelines for lookback studies of blood products."

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* For more information, please contact the medical representatives of your local JRC blood center.

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