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)

---

1) Alveolar shadow
   - Enlarged cardiac shadow
   - Pleural effusion
   - Interlobular fissure hypertrophy
   - Kerley’s B line
   - Perihilar vascular congestion

Courtesy of Dr. Hitoshi Okazaki, Department of Blood Transfusion, the University of Tokyo Hospital
**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. 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 | 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.
| 18:00 | BT 36.2˚C, BP 190/120 mmHg, HR 110/min
| 18:25 | Transfusion of one bag of RBCs was initiated (transfusion rate: 2.5 mL/min).
| 20:17 | RBC transfusion was completed.
| 21:00 | The patient developed palpitations, dyspnea, cyanosis and peripheral coldness.
| 21:10 | Pulmonary murmur, moist rales and wheezing sounds were heard on auscultation.
| 21:36 | Blood gas values were pH 7.029, PaO 2 63.6 mmHg, PaCO2 48.6 mmHg, Spo2 99.0% (mechanical ventilation: FiO2 50%).
| 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.
| 22:45 | Bilateral infiltrates and cardiomegaly were investigated on chest X-ray.
| 23:00 | BiPAP assist, FiO 2 60% on mechanical ventilation, PEEP 20.0.
| The next day | .................................................................
| 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%).

**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 | Before transfusion: BT 36.4˚C, BP 160/80 mmHg, HR 107/min, Spo2 96% (room air), Hb was 6.2 g/dL.
| 16:50 | One small bag of RBCs was transfused (transfusion rate: 2.3 mL/min).
| 17:50 | Another small bag of RBCs was additionally transfused. Spo2 95% (RA).
| 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.
| 21:00 | The patient developed dyspnea. BT 37.1˚C, BP 192/90 mmHg, HR 120/min. Blood gas values were pH 6.964, PaO2 35.2 mmHg, PaCO2 80.5 mmHg, Spo2 40.5% (O2: at 4 L/min through a mask). Mechanical ventilation with BiPAP was started.
| 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.
| The next day | .................................................................
| 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.

**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]

3) SHOT Annual Reports and Summaries (http://www.shotok.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.”

**Japanese Red Cross Society Hemovigilance**

Issued by: Medical Information Division, Blood Service Headquarters, Japanese Red Cross Society 1-1-3, Shiba Daimon, Minato-ku, Tokyo 105-8521, Japan

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

Hemovigilance Information in English

![QR Code]

[1602]