Transfusion-Related Acute Lung Injury Following Upper Extremity Replantation

Üst Ekstremite Replantasyonu Sonrası Gelişen Transfüzyona Bağlı Akut Akciğer Hasarı

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**Abstract**

Transfusion-related acute lung injury (TRALI) is a well described serious complication of blood product transfusion (1-4). It is the fourth most commonly reported transfusion reaction and the third leading cause of transfusion-related mortality in the USA (2-5). The incidence reported in 1985 was 1 in 5000 units transfused at the Mayo Clinic (6). However, the true incidence remains unknown because clinicians may not recognise TRALI when it occurs; therefore, it is likely underreported to blood centres. There is still no consensus on the incidence, pathogenesis or laboratory diagnosis of the syndrome.

TRALI occurs after transfusion of plasma-containing products, as a result of a cross-reaction between donor antibodies and host leukocytes (4). All blood products have been associated with TRALI, including whole blood, packed red cells, platelet products, fresh frozen plasma, and rarely, cryoprecipitate, i.v. immunoglobulin and stem cell preparations (3).

TRALI is defined as an acute lung injury syndrome that occurs during or within 6 hours of transfusion, as indicated by the presence of bilateral pulmonary oedema, hypoxemia and dyspnea with normal cardiac function. Other findings observed in TRALI are hypertension or hypotension, fever and acute transient leukopenia (5). An increased clinical awareness of this potentially life-threatening adverse reaction is especially important in anaesthesia. The primary treatment of TRALI is supportive care with supplemental oxygen to treat hypoxemia and mechanical ventilation to treat respiratory failure. TRALI is generally reported to have a good prognosis with supportive therapy. It is important to distinguish TRALI from other causes of pulmonary oedema to reduce the morbidity and mortality of TRALI. It is important to discuss this condition in order to prevent such serious complication of blood product transfusion.

**Introduction**

Transfusion-related acute lung injury (TRALI) is a common adverse effect of blood transfusion that is often underrecognised and underreported. We would like to report a case of TRALI after the replantation and transfusion of blood components in a male patient who had sustained a complete amputation of the right upper extremity. The level of amputation was just proximal to the humeral condyles. Replantation was performed 5 hours after the accident and 36 units of blood products were transfused intraoperatively. Subsequently, during the early postoperative period, TRALI was revealed. In this case report, the circumstances of this injury and preventive measures are discussed to understand and recognise this condition in order to reduce the morbidity and mortality of TRALI. It is important to distinguish TRALI from other causes of pulmonary oedema because early diagnosis and management are associated with a favourable outcome.

**Key words:** Blood transfusion, microsurgery, acute lung injury

**Case Report**

A 21-year-old male sustained a complete amputation of the right upper extremity when he was receiving food from a food elevator. The right arm was amputated just proximal to the humeral condyles (Figure 1, 2). Replantation was performed 5 hours after the accident.
Anatomic structures were prepared for anastomosis by separating the layers of tissues under general anaesthesia. The humerus was initially shortened by about 2 cm and stabilised with a Y-shaped dynamic compression plate. The brachial artery and cephalic vein were immediately anastomosed using 9-0 prolene sutures. The ulnar nerve, median nerve, and radial nerve were anastomosed together with the musculotendinous structures. The nerves were microsutured with epineural 10-0 sutures at the level of the cubital fossa. The muscles were anastomosed in corresponding layers using mattress sutures. As much as possible, we reconstructed the anatomic continuity of the muscles. Moreover, to ensure appropriate venous drainage, we connected four other subcutaneous veins of diameter less than 2 mm. Five units of whole blood, 13 units of fresh frozen plasma, eight units of platelets and ten units of packed red cells were transfused intraoperatively.

Postoperatively, the patient was transferred to the intensive care unit in haemodynamically stable condition. However, during the early postoperative period, the patient became hypoxic and hypotensive with a fall in central venous pressure. A chest x-ray demonstrated extensive bilateral pulmonary infiltration (Figure 3).

A differential diagnosis of pulmonary embolism, aspiration pneumonitis or pulmonary oedema was suspected. A clinical diagnosis of TRALI, probably transfusion-related, was made after excluding other causes. Samples of the whole blood, fresh frozen plasma, platelets and red cells used and a sample of the patient’s blood were sent to the biochemistry service for analysis for regrouping, typing and antibody screening. Subsequently, a diagnosis of TRALI was made on clinical sequence and the basis of HLA antibodies detected in the donor’s plasma by intensive care doctors. Ventilatory support was continued with low tidal volume (6 mL/kg), high PEEP (15 cm H₂O) and high frequency (16/min). Haemodynamic stability was maintained. In addition, the patient received a high-dose corticosteroid regime (hydrocortisone 600 mg/24 h) for 5 days. On postoperative day six, the patient’s condition improved rapidly and a repeat x-ray showed marked resolution of the pulmonary infiltration. On postoperative day seven, the patient was weaned from the ventilator and his trachea was extubated. He was discharged from the hospital in good condition 45 days after surgery. The patient was followed-up for 11 months (Figure 4).

**Discussion**

The classically reported risks of blood transfusion include urticaria, tachypnoea, dyspnea, hypotension, haemoglobinuria, oliguria, bronchospasm and infectious transmission. Of all adverse reactions associated with transfusion, TRALI is an uncommon and most serious complication to transfusion of any plasma-containing blood components. TRALI has been increasingly recognised over the past two decades. TRALI is a cause of acute respiratory distress...
The presence of large volumes of frothy white or pink tracheal aspirate and hypoxia, such as volume overload, congestive heart failure and myocardial infarction. Cardiac causes of pulmonary insufficiency have to be ruled out with the aid of a Swan Ganz catheter and echocardiography. Normal central vascular and pulmonary wedge pressures and the absence of jugular vascular distension are consistent with TRALI. They are typically increased in myocardial infarction and circulatory overload. There is no definitive laboratory test for the diagnosis of TRALI. Leukopenia and neutropenia have been observed in case reports in the literature. However, leukopenia may be easily missed later because the white blood cell count returns to normal within hours, when the marginating pool of neutrophils moves into the circulation (8).

The present patient had a diagnosis of TRALI based on the clinical symptoms and findings, including bilateral pulmonary oedema without cardiac causes after transfusion. TRALI is transient and reversible, and resolves rapidly in most patients. Intubated patients develop oxygen desaturation and froth which may be observed in the endotracheal tube if the patient is supine (11). There is no specific treatment for TRALI. The treatment should consist of appropriate respiratory support. For acute management, any transfusion should be stopped immediately and supportive care provided to the patient. With supportive therapy, most patients recover without permanent pulmonary disease (11, 12). Lung support until pulmonary permeability is a therapeutic option for refractory and life-threatening hypoxemia. It is important to improve the pulmonary capillary wedge pressure and cardiac output. In addition, cardiac and renal support is essential. Diuretics have not been shown to have any benefit because the pulmonary oedema in TRALI is not due to volume overload, and the use of diuretics may result in decreased cardiac output and worsening of hypotension (8, 11). Other treatments that have been used for TRALI include high-dose steroids and plasmapheresis. However, there is no evidence to support the use of glucocorticoids (12).

TRALI is a serious, potentially life threatening condition as a consequence of blood product transfusion which is underrecognised and underreported. It is a leading cause of mortality and morbidity reported in the last several years. It is important to distinguish TRALI from other causes of pulmonary oedema because early diagnosis and management are associated with a favourable outcome. The diagnosis of TRALI requires a high degree of suspicion and the best treatment results are obtained in cases where the diagnosis is made early. Clinical vigilance is important for the recognition and treatment of this syndrome. For this reason, more attention focused on TRALI is needed for clinicians to recognise this transfusion reaction. Further work is required to prevent the effects of this life-threatening syndrome.

Authors’ contributions
Conceived and designed the study: YK, CeS, CS, SO, HD, FY. Examination and follow-up of the patient: YK, CeS, CS, SO, HD, FY. Analysed the data: YK, CeS, CS, FY. Wrote the paper: YK, CeS, CS, SO, HD, FY. All authors read and approved the final manuscript.

Conflict of interest
No conflicts of interest were declared by the authors.
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