

Case Report

Transfusion-related acute lung injury and transfusion-associated circulatory overload: Clinicoradiographic picture of common entities uncommonly reported!!

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ABSTRACT

Transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO) are post-transfusion life-threatening pulmonary complications. We report a case of TRALI in a 25-year-old postpartum female. Various investigators in past have published these entities in critical care/hematology literature; however, there is a lack of awareness among reporting radiologists, due to paucity of literature in radiology journals. This report aims at discussing clinicoradiographic picture of TRALI and its close differential TACO. This would help in enhancing knowledge of these uncommonly reported entities, and preventing significant morbidity and mortality by initiating appropriate management by critical care clinicians.

Keywords: Transfusion-related acute lung injury, Transfusion-associated circulatory overload, Transfusion, Pulmonary complications

INTRODUCTION

Transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO) are life-threatening transfusion-related pulmonary complications, presenting as acute respiratory distress syndromes with often overlapping clinicoradiographic pictures. Differentiating these two can be challenging for clinicians, leading to delayed or inaccurate diagnosis. Although these complications have been extensively reported in critical care literature, there is paucity of literature on radiographic features in Radiology journals.^[1-5] The purpose of this report is to discuss the clinicoradiographic features of these two entities, especially highlighting the key differentiating findings, in an attempt to guide clinicians in early diagnosis and appropriate management.

CASE REPORT

A 25-year-old female underwent emergency lower segment cesarean section due to foetal distress, transfused with 2 pints of blood, because of peripartum blood loss. After 2 h of blood transfusion, she developed acute onset dyspnea, tachypnea (Respiratory rate of 60/min), and hypoxia (SpO₂-82%) for which she was admitted to the intensive care unit (ICU). Her further blood transfusions were stopped. At the time of admission, she was febrile, with normal blood pressure.

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Medical history was insignificant. On clinical examination, no neck vein distension or abnormal heart sounds or murmurs was observed. Chest X-ray at the time of admission, showed diffuse interstitial and patchy alveolar air space opacities in bilateral lungs, with a prominent right horizontal fissure (likely due to fissural effusion), with no obvious cardiomegaly [Figure 1]. Bedside echocardiography was normal with good systolic and diastolic function with a normal size of cardiac chambers. Supportive care was started with oxygen administration (6L/min) on a nasal cannula. However, the patient was intubated owing to increasing respiratory distress and the inability to maintain adequate oxygen saturation. Complete blood counts revealed mild leukocytosis, varying from 15,000 to 26,000. Pro-BNP was found to be within the normal range. Serological assay for antibodies to human leukocyte antigen (HLA) and human neutrophil antigen (HNA) could not be done, due to non-availability in emergency. The patient was stable in ICU and showed clinical improvement the next day. Follow-up chest X-ray after 48 h of ICU admission revealed near complete resolution of pulmonary opacities [Figure 2]. Clinicrodiographic picture of this patient was suggestive of TRALI over TACO.

DISCUSSION

TRALI and TACO are post-transfusion reactionary pulmonary edema, seen after transfusing blood products like whole blood, fresh frozen plasma, platelets, cryoprecipitate, granulocytes, intravenous immune globulin, allogeneic/autologous stem cells, and packed red blood cells.^[1,2,6,7] These are broadly defined as acute respiratory distress, new onset hypoxemia, and bilateral pulmonary infiltrates on chest X-ray occurring within 6 h of blood transfusion.^[8,9] According to Food and Drug Administration report, TACO is the second most common cause of transfusion-related fatalities (10% in TACO, 65% in TRALI).^[10] The National Heart, Lung, and Blood Institute working group and Canadian Consensus conference guidelines defined TRALI as “new acute lung injury (ALI) that occurs during or within 6 h after transfusion of blood products, with a clear temporal relationship, in patients with or without risk factors for ALI other than transfusion.”^[3,7] TRALI was first reported in 1950, but the term was coined by Popovsky *et al.* in 1983.^[4-8] About 5–25% of TRALI cases are reported to be fatal, with most of the patients showing full recovery within 72 h.^[3,5,7]

TRALI is a permeability/non-cardiogenic pulmonary edema, while TACO is hydrostatic/cardiogenic pulmonary edema.^[7] TRALI occurs due to neutrophil-mediated damage to pulmonary capillaries, leading to exudative protein-rich fluid leak into alveolar space. Two hypotheses have been proposed in the medical literature regarding the etiopathogenesis of TRALI. First is the presence of donor antibodies against HLA/HNA expressed in the recipient's



Figure 1: Chest X-Ray at the time of admission to intensive care unit revealed diffuse interstitial and patchy alveolar air space opacities in bilateral lung fields, with a prominent right horizontal fissure (likely due to fissural effusion), with no obvious cardiomegaly. Findings were consistent with the imaging morphology of acute respiratory distress syndrome.

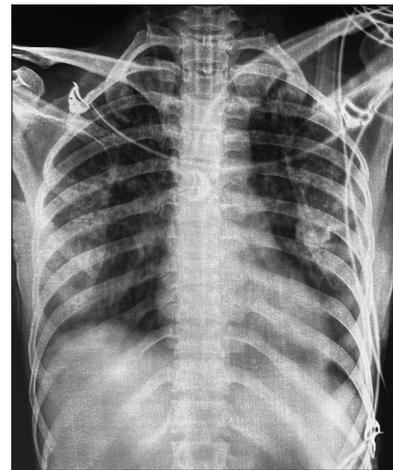


Figure 2: Repeat chest X-Ray obtained 48 h after the admission to intensive care unit revealed almost complete clearing of bilateral pulmonary opacities. This rapid resolution of radiographic findings on stoppage of blood transfusion was consistent with transfusion-related acute lung injury.

pulmonary capillaries, which cause capillary damage. The second explanation is “Two Hit Hypothesis,” wherein the patient has an underlying inflammatory condition like sepsis or recent surgery which acts as the primary stimulus, causing neutrophil sequestration in pulmonary capillaries.

Table 1: The key differentiating features of TRALI and TACO.

Clinico-radiographic features	TRALI	TACO
Pulmonary edema type	Exudative	Transudative
Body temperature	Usually increased	No change
Blood pressure	Hypotension	Hypertension
Neck veins	No change	May be distended
Auscultation	Rales present	Rales±S3
Chest X-ray	Bilateral diffuse interstitial and alveolar infiltrates	Bilateral diffuse interstitial and alveolar infiltrates, ±cardiomegaly±pleural effusion
Echocardiography (ECHO)	Usually normal, with normal or decreased Ejection fraction	Systolic dysfunction may be present, with usually increased ejection fraction
Fluid balance	Normal or negative	Positive
Response to diuretic	Not significant	Significant change
White blood cell count	Increased or Transient decrease in counts	Unchanged
Brain natriuretic peptide (BNP) and n-terminal pro-brain natriuretic peptide (NT-pro BNP)	Normal or low	Usually Increased
Leukocyte antibodies	Donor leukocyte antibodies present, cross match incompatibility between donor and recipient	Usually not seen

TRALI: Transfusion-related acute lung injury, TACO: transfusion-associated circulatory overload

The transfused blood products containing antibodies and bioactive lipids activate these sequestered neutrophils to release proteases, damaging the capillary endothelium.^[3-5,7,9] TACO results from acute congestive heart failure with increased central venous pressure and pulmonary blood volume leading to increased hydrostatic pressure and fluid extravasation into alveolar space.^[1,2,6,7]

The clinical presentation of TRALI includes fever, hypotension, tachycardia, dyspnea, and sometimes a transient decrease in neutrophil count, with a need for mechanical ventilation.^[1,2,6-9] Chest X-ray shows pulmonary edema, with interstitial and pulmonary alveolar opacities, and septal lines, with or without pleural effusions.^[1,2,6,7,9] These lung opacities usually clear within 96 h in 80% of patients.^[1] Conversely, TACO presents with dyspnea, tachypnea, jugular venous distension, elevated systolic blood pressure, and S3 on auscultation.^[1,2,6-9] Patients younger than 3 years or older than 60 years are generally at higher risk of TACO, due to higher probability of underlying occult cardiac dysfunction, which manifests after blood transfusion as acute congestive heart failure.^[5,7] An important biomarker, B-type natriuretic peptide (BNP) may help in differentiating TACO from TRALI, as cardiogenic pulmonary edema in TACO results in myocardial stretching leading to increased post-transfusion BNP values.^[5,7] The key differentiating features between TRALI and TACO are enumerated in Table 1.

The management mainly involves immediate discontinuation of further transfusion of blood products.^[1-10] In clinicoradiographically suspected cases of TRALI, treatment includes supplemental oxygen, and careful fluid administration, with the requirement of ventilatory

and pharmacologic pressure support in severe cases.^[1,2,6,7] While in clinicoradiographically suspected cases of TACO, treatment includes supplemental oxygen, diuretics for fluid overload, and mechanical ventilation if needed. The incidence of TACO can be reduced by recipient screening for undiagnosed cardiac insufficiency and by decreasing the rate and volume of transfusions.^[1,2,6-9] Conversely, the incidence of TRALI can be reduced by screening the donors for HLA/HNA antibodies, refusing donors with a previous history of transfusion reaction, and using male-only donors.^[2,6,7]

CONCLUSION

TRALI and TACO are post-transfusion acute respiratory distress pulmonary edema carrying high morbidity and mortality. A better understanding of these entities by radiologists would help in dispensing an early and accurate report, aiding in differentiating cardiogenic from non-cardiogenic edema, thereby guiding the clinicians in ordering appropriate investigations, planning further management, and lowering the associated mortality.

TEACHING POINTS

1. Transfusion-related acute lung injury (TRALI) and Transfusion-associated circulatory overload (TACO) are life-threatening transfusion-related pulmonary complications, presenting as acute respiratory distress syndromes.
2. TRALI is a permeability/non-cardiogenic pulmonary edema, while TACO is hydrostatic/cardiogenic pulmonary edema.

MCQs

1. TRALI stands for?
 - a. Transfusion-related acute lung injury
 - b. Transfusion-related acute lung infection
 - c. Transfusion-related acute lung inflammation
 - d. Transfusion-related acute lung illness

Answer Key: a

2. TACO stands for?
 - a. Transfusion-associated cardiac overactivity
 - b. Transfusion-associated cardiac overload
 - c. Transfusion-associated coronary occlusion
 - d. Transfusion-associated circulatory overload

Answer Key: d

3. Which of the following statement regarding post transfusion pulmonary complications is incorrect?
 - a. TRALI occurs due to exudative pulmonary edema
 - b. TACO occurs due to hydrostatic pulmonary edema
 - c. Donor leukocyte antibodies are present in TACO
 - d. Cardiomegaly with pleural effusion is commonly observed in TACO

Answer Key: c

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

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Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the

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REFERENCES

1. Murphy CE, Kenny CM, Brown KE. TACO and TRALI: Visualising transfusion lung injury on plain film. *BMJ Case Rep* 2020;13:e230426.
2. Carcano C, Okafor N, Martinez F, Ramirez J, Kanne J, Kirsch J. Radiographic manifestations of transfusion-related acute lung injury. *Clin Imaging* 2013;37:1020-3.
3. Skeate RC, Eastlund T. Distinguishing between transfusion related acute lung injury and transfusion associated circulatory overload. *Curr Opin Hematol* 2007;14:682-7.
4. Semple JW, Rebetz J, Kapur R. Transfusion-associated circulatory overload and transfusion-related acute lung injury. *Blood* 2019;133:1840-53.
5. Sherif L, Srikanth J, Jain P, Shetty K, Khandige B. A suspected case of transfusion related acute lung injury. *Lung India* 2011;28:216-8.
6. Silliman CC, Ambruso DR, Boshkov LK. Transfusion-related acute lung injury. *Blood* 2005;105:2266-73.
7. Fatalities reported to food and drug administration (FDA) following blood collection and transfusion; Annual Summary for Fiscal Year 2017.
8. Toy P, Popovsky MA, Abraham E, Ambruso DR, Holness LG, Kopko PM, *et al.* Transfusion-related acute lung injury: Definition and review. *Crit Care Med* 2005;33:721-6.
9. Triulzi DJ. Transfusion-related acute lung injury: An update. *Hematol Am Soc Hematol Educ Program* 2006;1:497-501.
10. Aubron C, Aries P, Le Niger C, Sparrow RL, Ozier Y. How clinicians can minimize transfusion-related adverse events? *Transfus Clin Biol* 2018;25:257-61.

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