TRALI: A fatal risk of blood transfusion in postpartum hemorrhage - the last straw phenomenon

Rachida Mansouri[1]*, Abdelhamid Sadi[2]

[1]Department of Anesthesiology and Intensive Care, Mohamed Lamine Debaghine University Hospital Center Bab El Oued, Algiers,
[2] Intensive Care Unit (ICU), Specialized Hospital Establishment El-Hadi-Flici, El-Kettar
[1, 2] Faculty of Health Sciences, University of Algiers 1 – Benyoucef Benkhedda

***For Correspondence**: Email: * r.mansouri@univ-alger.dz; Phone: +213 559312976

Résumé

La Transfusion-Related Acute Lung Injury (TRALI) est une complication potentiellement grave associée à la transfusion sanguine. Elle se caractérise par une insuffisance respiratoire aiguë qui survient généralement dans les six heures suivant la transfusion de produits sanguins. Étant donné la similitude de ses symptômes avec ceux d'autres troubles respiratoires, le diagnostic peut parfois être difficile à établir. Toutefois, il est important de considérer ce diagnostic chez tout patient présentant des symptômes de détresse respiratoire aiguë après une transfusion.

Nous rapportons ici le cas d'une patiente ayant survécu à une transfusion massive en raison d'une hémorragie post-partum, mais qui a développé un TRALI mortel deux jours après une retransfusion. Ce cas met en évidence l'importance pour les médecins d'évaluer soigneusement la nécessité de transfusion chez chaque patient, en prenant en compte les risques et les avantages potentiels de cette intervention médicale.

Keywords: Transfusion related acute lung injury, hémorragie post-partum, transfusion

Abstract

Transfusion-Related Acute Lung Injury (TRALI) is a potentially serious complication associated with blood transfusion. It is characterized by acute respiratory failure that typically occurs within 6 hours after the transfusion of blood products. Given the similarity of its symptoms with those of other respiratory disorders, the diagnosis can sometimes be difficult to establish. However, it is important to consider this diagnosis in any patient presenting with symptoms of acute respiratory distress following a transfusion. Here, we report the case of a patient who survived massive transfusion due to postpartum hemorrhage but unfortunately developed fatal TRALI two days after a retransfusion. This case highlights the importance for physicians to carefully evaluate the need for transfusion in each patient, taking into account the potential risks and benefits of this medical intervention.

Keywords: Transfusion related acute lung injury, postpartum haemorrhage, transfusion

Introduction

Transfusion-related acute lung injury also known as, TRALI, is a serious complication that occurs rarely but is one of the leading causes of transfusion-related morbidity and mortality in developed countries (1) (2). It is considered post-transfusion if it occurs within six hours of the transfusion of a blood component and there is no temporal relationship with other risk factors (3). . This acute immunological reaction happens when antibodies in the donor plasma react with antigens on the recipient's leukocytes, leading to activation of endothelial cells and

an inflammatory response that affects the lungs(4) (5). TRALI is a risk for pregnant women, especially in the obstetrical setting where haemorrhage and blood transfusion are common events. It is important for health professionals to be aware of the risks of TRALI and carefully monitor symptoms in transfused patients. This case serves as a significant reminder that blood transfusion can be an effective treatment in various medical circumstances. However, it is crucial to thoroughly consider the potential risks and benefits before administering a transfusion.

Case report:

A 30-year-old woman who had a previous abortion and a possible case of gestational thrombocytopenia experienced postpartum haemorrhage after delivering vaginally for the second time. The medical team performed a uterine revision under general anaesthesia, but the patient continued to experience severe bleeding and uterine inertia despite medical interventions. The team decided to transfuse the patient with 6 packed red blood cells, 6 fresh frozen plasmas and 6 platelet concentrates due to her hemodynamic instability. Despite the team's efforts to control the bleeding by performing uterine and hypogastric artery ligation, a hysterectomy was ultimately necessary. Once the patient was stable, she was extubated and moved to the post-interventional care unit for monitoring. The patient's hemoglobin level was 11.7 g/dl, platelet count was 40,000/mm3, PT was 50%, fibrinogen level was 2.2 g, and creatinine level was 27 mg/ml. Due to a decrease in hemoglobin to 7g/dl and platelets to 11,000/mm3 on postoperative day 2, the patient was given two units of packed red blood cells and platelets to transfuse. However, three hours later, the patient experienced difficulty breathing, heart palpitations, and chest pain. The patient's clinical examination revealed a rapid heart rate of 120 b/min, blood pressure of 120/70 mmHg, and sibilant rales on pulmonary auscultation. The patient's pulse oxygen saturation (SpO2) was at 87%. Additionally, arterial blood gas revealed severe hypoxia with a PaO2 of 45 mmHg on room air. The frontal chest X-ray indicated bilateral alveolar-interstitial snowstorm images with a normal cardiac silhouette, while the CT scan showed anterobasal and right laterobasal segmental embolism without any signs of PAH and acute pulmonary edema.

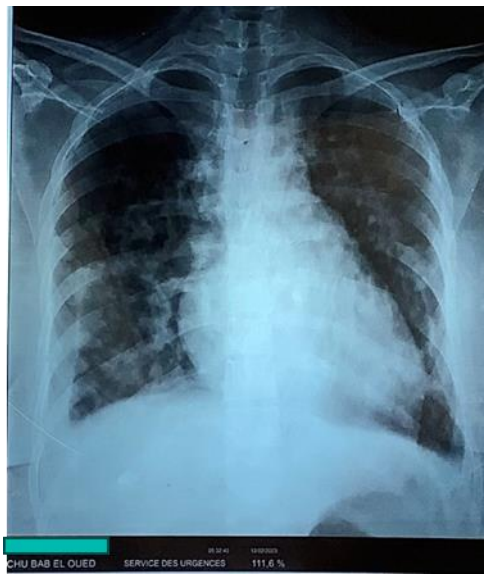

Figure 1: Chest X-ray showing bilateral pulmonary edema with bilateral patchy infiltrates suggestive of TRALI

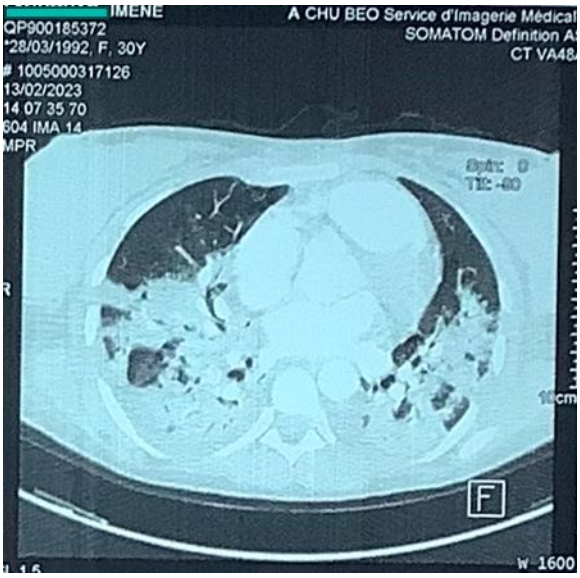

Figure 2: Axial computerized tomography scan of the chest, one day after retransfusion.
These images demonstrate extensive bilateral parenchymal disease

The patient's treatment involved the use of protective artificial ventilation and deep sedation, along with the management of renal failure. Unfortunately, on the fourth day, the patient's respiratory and renal condition deteriorated, leading to cardiocirculatory arrest.

Table 1: table summarizing the chronology of events

Features	Day 0 Pre-transfusion	Day 0 PPH/hysterectomy After transfusion of 06 CG, 06 PFC, 06 CPS	Day 2 PPH/hysterectomy Before transfusion of 02 GC	Day 2 PPH/hysterectomy After transfusion of 02 GC
First symptom			Tachypnea and hypoxemia	
Time to onset of symptoms			3h	
Blood pressure PAS/PAD (mmHg)	100/75	109/82	90/65	130/85
Heart rate (beats/min)	80	90	100-120	100-120
Respiratory rate (breaths/min)	18	21	20	40
Oxygen saturation	98%	99%	96%	88%
PaO2 (mmHg)	—	—	—	45
PaO 2 /FiO 2 ratio	—	—	—	209
PH	—	—	—	7,30
Mechanical ventilation required	—	—	No	Yes
Lactate (mmol/l)	—	—	—	1,8
Hb(g/dl),plq(elt/mm3),	9.3/ 79 000	11.7/ 40 000	7/ 11 000,	9.1/ 24 000
Leukocytes (elt/mm3)	6 000			9 600
TP (%)	70	50		58
Urea (g/l), creatinine (mg/l)	0.27/13	0.59/27	0.95/ 40	1.47/ 57
Diuresis (ml/kg/h)	—		0.78	0.15
Vasopressors	—		Non	Non
Temperature (°C)	37		37.0	37.0
Pulmonary auscultation	—	—	—	Supra-sternal and intercostal tugging Bilateral sibilant rales, crackling rales at both bases
Chest X-ray	—		—	Perihilar alveolar oedema and uneven consolidation
Chest CT scan				Anterobasal and right laterobasal segmental embolism without signs of PAH. Acute pulmonary edema
Length of stay in intensive care				36 hours
Evolution				Deaths

Discussion:

The occurrence of TRALI is difficult to determine due to its unacknowledged and underreported status. In North America, it has been reported to have an incidence of 1 in 1,333 to 5,000 per transfused unit, while in Europe, it ranges from 1 in 29,000 to 270,000 per transfused unit (6).

The pathogenesis of TRALI is complex and not yet fully comprehended (7). The authors propose a "two-strike" process, where the patient's pro-inflammatory condition serves as the "first strike" and the transfusion acts as the "second strike" (6).The blood product may contain anti-HLA or anti-HNA antibodies that bind to neutrophil surface antigens, or biological response modifiers that activate these adherent and functionally hyperactive neutrophils (8). TRALI has two types of risk factors - transfusion-related and patient-related. When these two intersect, the risk increases (7). Some of the risk factors include recent surgery, liver transplantation, postpartum haemorrhage, the number of transfusions and units of fresh frozen plasma, age, female gender, smoking, chronic alcohol abuse, positive fluid balance, pre-transfusion shock, ASA score, and mechanical ventilation (9) .

Postpartum haemorrhage can increase the risk of TRALI due to the high prevalence of leukocyte antigens in women with previous pregnancies (4). The symptoms of TRALI are similar to those of pulmonary oedema caused by other factors. They usually occur during or within six hours of transfusion (10). Diagnosis is based on non-specific criteria such as tachycardia, tachypnoea and hypoxia with SpO2. The diagnostic criteria for TRALI are not specific and may include tachycardia, tachypnea, and hypoxia, where SpO2 is less than 90% on room air. Clinical examination may reveal hypoxic respiratory distress, and pulmonary auscultation may reveal crackles without any evidence of congestive heart failure or fluid overload (11). Signs of bilateral pulmonary edema, which is not related to heart failure, can be seen on chest radiography, with diffuse bilateral infiltrates. This may rapidly progress to complete lung blankness, making it impossible to distinguish TRALI from respiratory distress syndrome (ARDS). There should be no left atrial hypertension, and if there is, it should not be the primary cause of hypoxemia. Physiological data indicates hypoxemia and normal cardiac function on the echocardiogram. The occurrence of TRALI (Transfusion-Related Acute Lung Injury) in patients who have received transfusions, and do not have any other causes of ALI (Acute Lung Injury), is enough to diagnose TRALI. The required immunological work-up should also be initiated. Treatment involves providing oxygen at the first signs of the syndrome, and using vasoactive agents to maintain haemodynamic stability. Mortality rate is estimated to be between 5-13%, with patients who survive making a full recovery without any lung complications. All labile blood products that contain plasma have been found to be implicated in TRALI (12). To minimize the risk of TRALI and other transfusion-related complications, it is important to follow proper transfusion guidelines and protocols. Health professionals and doctors should ensure that transfusions are only given when necessary and using the most suitable blood products for each patient. It is crucial to ensure that donors go through thorough screening and testing of their plasma in order to identify any antibodies that may lead to immune reactions in recipients. Furthermore, patients must be closely monitored during and after transfusion to detect any signs of reactions or complications early. While blood transfusions can save lives, it is important to perform them with utmost care and caution to prevent any potential complications, such as TRALI.

Conclusion:

TRALI, unfortunately, cannot be entirely eliminated. However, its occurrence can be lowered by using blood components and plasma proteins only when necessary. Furthermore, it is crucial for medical staff at

hospitals to remain observant when it comes to diagnosing TRALI.

Conflict of interest: There are no conflicts of interest.

References

1. Jhaveri P, Bozkurt S, Moyal A, Belov A, Anderson S, Shan H, et al. Analyzing Real World Data of Blood Transfusion Adverse Events: Opportunities and Challenges. Transfusion. mai 2022;62(5):1019-26.
2. Fuller CC, Nambudiri VE, Spencer-Smith C, Curtis LH, Shinde M, Cosgrove A, et al. Medical chart validation of inpatient diagnosis codes for Transfusion Related Acute Lung Injury (TRALI) 2013–2015. Transfusion. mars 2021;61(3):754-66.
3. Kleinman S, Caulfield T, Chan P, Davenport R, McFarland J, McPhedran S, et al. Toward an understanding of transfusion-related acute lung injury: statement of a consensus panel: TRALI CONSENSUS PANEL STATEMENT. Transfusion. déc 2004;44(12):1774-89.
4. Kogutt BK, Vaught AJ. Postpartum hemorrhage: Blood product management and massive transfusion. Seminars in perinatology. févr 2019;43(1):44.
5. Zeeuw Van Der Laan EAN, Van Der Velden S, Porcelijn L, Semple JW, Van Der Schoot CE, Kapur R. Update on the pathophysiology of transfusion-related acute lung injury. Current Opinion in Hematology. nov 2020;27(6):386-91.
6. Kuldanek SA, Kelher M, Silliman CC. Risk factors, management and prevention of transfusion-related acute lung injury: a comprehensive update. Expert Rev Hematol. sept 2019;12(9):773-85.
7. Semple JW, Rebetz J, Kapur R. Transfusion-associated circulatory overload and transfusion-related acute lung injury. Blood. 25 avr 2019;133(17):1840-53.
8. Jongerius I, Porcelijn L, van Beek AE, Semple JW, van der Schoot CE, Vlaar APJ, et al. The Role of Complement in Transfusion-Related Acute Lung Injury. Transfus Med Rev. oct 2019;33(4):236-42.
9. Hu L, Wang B, Jiang Y, Zhu B, Wang C, Yu Q, et al. Risk Factors for Transfusion-Related Acute Lung Injury. Respir Care. juin 2021;66(6):1029-38.
10. Toy P, Popovsky MA, Abraham E, Ambruso DR, Holness LG, Kopko PM, et al. Transfusion-related acute lung injury: Definition and review. Critical Care Medicine. avr 2005;33(4):721.
11. Roubinian N. TACO and TRALI: biology, risk factors, and prevention strategies. Hematology Am Soc Hematol Educ Program. 30 nov 2018;2018(1):585-94.
12. Aravinthan A, Sen S, Marcus N. Transfusion-related acute lung injury: a rare and life-threatening complication of a common procedure. Clinical Medicine. 1 févr 2009;9(1):87-9.