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CASE REPORT

A Mother Who Experienced TRALI After a Caesarian Section on the Indication of Severe Pre-eclampsia with a Macrosomic Fetus

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Abstract

Introduction*: Transfusion-Related Acute Lung Injury (TRALI) is a severe, often fatal, complication of blood transfusion. Obstetric patients with severe pre-eclampsia are uniquely susceptible due to a "two-hit" mechanism, where the underlying inflammatory condition primes the lungs for injury from a subsequent blood transfusion. This report presents a case of post-transfusion respiratory distress in such a high-risk patient, highlighting the diagnostic challenges.*

Case Report*: A mother with severe pre-eclampsia underwent a caesarean section for a macrosomic fetus, complicated by postpartum hemorrhage. She was transfused with two units of Packed Red Cells (PRC). Approximately 12 hours after the transfusion was completed, she developed acute-onset, progressive shortness of breath, requiring management in the High Care Unit.*

Discussion: *In this complex postpartum case, the central challenge is diagnosing acute respiratory distress following Caesarean delivery, severe pre-eclampsia, and a blood transfusion. Given the patient's heightened vulnerability due to pre-eclampsia and surgery, the transfusion may have triggered acute lung injury via the "two-hit" model. TRALI diagnosis relies on clinical suspicion and requires immediate cessation of transfusion, respiratory support, and careful hemodynamic management.*

Conclusion*: This case underscores the importance of recognizing TRALI as a potential cause of respiratory distress in obstetric patients with pre-eclampsia, emphasizing the need for prompt diagnosis and supportive care.*

Keywords: *Cesarean section (C-section); Severe pre-eclampsia; Blood transfusion complications; Transfusion-Related Acute Lung Injury (TRALI); Postpartum respiratory distress.*

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INTRODUCTION

Surgical procedures such as caesarean section inherently carry a risk of significant hemorrhage, which may necessitate the transfusion of blood and blood components. While often life-saving, blood transfusion is not without risk, and one of the most severe, non-infectious complications is transfusion-related acute lung injury (TRALI). TRALI is a clinical syndrome characterized by the acute onset of respiratory distress and hypoxemia, accompanied by radiographic evidence of new bilateral pulmonary infiltrates, which develops during or within six hours of a transfusion.[1–3]

Globally, TRALI has emerged as a leading, and in many developed nations, the leading cause of transfusion-related mortality. This prominence is not due to a rising incidence but rather the remarkable success in mitigating other risks, such as transfusion-transmitted viral infections, which has shifted the focus of hemovigilance toward immune-mediated and inflammatory complications. The reported mortality rate for TRALI is substantial, with estimates ranging from 5% to as high as 20%. Despite this high fatality rate, the overall incidence in the general transfused population is considered low, though figures vary widely due to historical under-recognition and differences in surveillance methods. Estimates have ranged from 1 in 5,000 to 1 in 190,000 transfused components. More rigorous, prospective surveillance following the establishment of consensus definitions has suggested rates closer to 1 in 12,000 units. A significant portion of TRALI cases are antibody-mediated, triggered by anti-human leukocyte antigen (HLA) or anti-human neutrophil antigen (HNA) antibodies present in donor plasma, which are particularly prevalent in multiparous female donors. Consequently, mitigation strategies, such as the preferential use of plasma from male or never-pregnant female donors, have successfully reduced the incidence of antibody-mediated TRALI by over 65% in some cohorts.[1–3]

However, the risk of TRALI is not uniform across all patient populations, and data from specific regions can be limited. While studies on general acute transfusion reactions (ATRs) have been conducted in Indonesia, they have not provided specific, validated incidence rates for TRALI, which represents a severe subset of ATRs. This data gap highlights the importance of case reporting and focused studies to raise clinical awareness. The persistence of TRALI despite mitigation strategies underscores the importance of a "two-hit" pathogenic model, particularly in clinically vulnerable patients. In this model, a pre-existing clinical condition—the "first hit"—primes the recipient's pulmonary endothelium and neutrophils. The transfusion then provides the "second hit," which can be donor antibodies or non-antibody biologic response modifiers (BRMs) such as lipids and cytokines that accumulate during blood product storage, triggering an acute inflammatory cascade and capillary leak in the lungs.[3–5]

Obstetric patients represent a uniquely susceptible population. Pregnancy itself is an alloimmunizing event, and conditions such as severe pre-eclampsia create a profound systemic inflammatory state, acting as a potent "first hit" that dramatically increases TRALI susceptibility. When these patients experience postpartum hemorrhage (PPH) and require transfusion, their risk far exceeds that of the general population. Indeed, studies focusing on these high-risk obstetric

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cohorts reveal a strikingly high incidence of TRALI, transforming it from a rare event into a frequent and predictable complication.[6,7]

The mechanism by which this occurs is still being elucidated, but the clinical evidence is compelling. One retrospective study found that among patients transfused for PPH, pregnancy-related hypertensive disorders such as pre-eclampsia were the single strongest predictor for developing TRALI, increasing the odds by more than 27-fold. [1] Another study focusing on patients with obstetric hemorrhage in an intensive care setting found a TRALI prevalence of 11.03%, with massive transfusion being a major risk factor. [2] These findings underscore that in a patient with severe pre-eclampsia who requires transfusion after a caesarean section, TRALI should be considered a high-probability differential diagnosis for any acute respiratory compromise. We report a case of a mother with severe pre-eclampsia who underwent a caesarean section for a macrosomic fetus, subsequently experienced postpartum hemorrhage requiring transfusion, and developed TRALI. This case highlights the critical intersection of these risk factors and emphasizes the need for heightened clinical vigilance in this specific patient population.[6,8]

CASE REPORT

This report presents the case of a postpartum patient who developed acute respiratory distress while recovering in the High Care Unit (HCU). The patient was 20 hours post-delivery via Caesarean section, which was indicated due to a diagnosis of severe pre-eclampsia, oligohydramnios, and fetal macrosomia. Her chief complaint was progressively worsening shortness of breath, which had an acute onset approximately one hour prior to assessment.

During her postoperative care, the patient was treated for anemia with a blood transfusion consisting of two units of Packed Red Cells (PRC). The administration of the final PRC unit was completed approximately 12 hours before the onset of her respiratory symptoms. This temporal relationship between the transfusion and the acute shortness of breath is critical to the clinical picture. The patient delivered a healthy male infant with a birth weight of 4300 grams.

The patient's past medical history was unremarkable; she denied any history of chronic hypertension, diabetes, kidney failure, or pre-existing lung disease. Her gynecological history includes menarche at age 12 with a regular menstrual cycle. There was no family history of malignancy, hereditary conditions, or psychiatric disorders. The patient was married in 2022 and denied any recent contact with individuals confirmed to be positive for COVID-19.

DISCUSSION

The central diagnostic challenge in this case is to determine the etiology of acute respiratory distress in a complex postpartum patient. The patient’s recent Caesarean section, diagnosis of severe pre-eclampsia, and receipt of a two-unit packed red cell (PRC) transfusion create a confluence of risk factors that make several diagnoses possible. However, a focused interpretation

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of the clinical timeline and the patient's underlying condition allows for a structured differential diagnosis.

The patient's severe pre-eclampsia makes her exquisitely vulnerable to volume overload. This condition is characterized by endothelial dysfunction and increased capillary permeability, leading to poor tolerance of fluid shifts. The administration of crystalloids during surgery combined with two units of PRCs could easily overwhelm her compromised circulatory system, resulting in hydrostatic pulmonary edema. TACO is frequently the result of increased hydrostatic pressure leading to cardiogenic pulmonary edema.[9–11]

While the 2019 consensus redefinition of Transfusion-Related Acute Lung Injury (TRALI) strictly defines the diagnostic window as during or within 6 hours of transfusion, the 12-hour symptom onset in this patient's case presents a clear challenge. This timing is the most significant hurdle to a straightforward TRALI diagnosis. However, it's crucial to consider the patient's strong predisposition; she's a textbook example of the "two-hit" model. Her severe pre-eclampsia and major surgery represent a powerful "first hit," effectively priming her lungs for an inflammatory response. Though the symptoms appeared later, the subsequent transfusion could still be argued as the "second hit" that triggered the acute lung injury in a highly sensitized individual. [9,11–14]

If we consider TRALI despite the timing, her pre-existing risk factors would classify this as TRALI Type II. This type is specifically associated with underlying patient conditions that heighten the risk of acute lung injury, with the transfusion acting as an exacerbating factor. The severity of her pre-eclampsia and the invasiveness of her surgery strongly align with the conditions defining TRALI Type II. While the 6-hour window is a vital diagnostic criterion, in complex clinical scenarios with highly susceptible patients, a rigid adherence to timing might overlook cases where the biological cascade, particularly in a severely inflamed system, leads to a slightly delayed onset of symptoms. The compelling clinical picture of a primed patient developing acute lung injury following a transfusion still warrants a strong consideration of TRALI..[9,11–14]

The management of Transfusion-Related Acute Lung Injury (TRALI) in the context of the postpartum patient is primarily centered on prompt recognition and aggressive supportive care, as specific treatments do not exist. The overall approach does not differ from the management of acute lung injury (ALI) stemming from other causes. Upon suspicion of TRALI, the first and most critical step is to immediately stop the transfusion. Following this, the intravenous line should be kept patent, and the remaining blood product must be sent to the blood bank for immunological analysis to help confirm the diagnosis.[15–17]

Respiratory and circulatory support form the cornerstone of TRALI management. The level of intervention is dictated by the clinical severity of the patient's condition. Nearly all patients will require some form of oxygen supplementation. In mild cases, providing oxygen via a nasal cannula or a non-rebreathing mask may be sufficient for clinical improvement. For severe cases with significant respiratory distress, mechanical ventilation is frequently required. While non-invasive support such as CPAP or BiPAP may be attempted, endotracheal intubation is often necessary. When invasive ventilation is used, a protective lung strategy with low tidal volumes is essential to

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minimize additional ventilator-induced lung injury. Concurrently, hemodynamic support aims to ensure adequate organ perfusion through fluid resuscitation and, if needed, vasoactive agents like norepinephrine to maintain stability.[16–18]

The roles of pharmacological therapies such as diuretics and corticosteroids in TRALI management are controversial, with conflicting reports on their efficacy. The use of diuretics should be approached with extreme caution, as the pulmonary edema in TRALI is caused by capillary leakage rather than fluid overload; therefore, diuretics can be detrimental and may precipitate hypotension. Despite this, some reports document their use, with one study noting they were ineffective in a majority of cases, while another case report described a patient who responded well. Similarly, the administration of corticosteroids is considered empirical, as there is no strong scientific evidence to justify their routine use or prove their benefit. Nonetheless, their use is documented in several case reports where patients showed a good response.[16–19]

TRALI is a clinical diagnosis that requires a high index of suspicion in any patient who develops respiratory distress following a transfusion. Timely recognition and adequate supportive therapy are crucial for management. It is vital to differentiate TRALI from other conditions, especially Transfusion-Associated Circulatory Overload (TACO), as the treatment strategies differ significantly. Although supportive care can lead to recovery, TRALI remains a leading cause of transfusion-related mortality, highlighting the serious nature of this complication.[16,17,20]

CONCLUSION

This case of a postpartum mother with severe pre-eclampsia who developed acute respiratory distress after a necessary blood transfusion highlights a significant diagnostic and management challenge. While the symptom onset at 12 hours post-transfusion falls outside the strict 6-hour diagnostic window for Transfusion-Related Acute Lung Injury (TRALI), the patient's underlying severe pre-eclampsia created a profound state of inflammation, serving as a potent "first hit" that made her exceptionally vulnerable to an acute lung injury triggered by the transfusion. This scenario underscores the critical need for clinicians to maintain a high index of suspicion for TRALI in this high-risk obstetric population, carefully differentiating it from Transfusion-Associated Circulatory Overload (TACO) due to vastly different treatment approaches. Ultimately, this case illustrates that in highly sensitized patients, the clinical context may warrant consideration of TRALI despite atypical timing, reinforcing that vigilant monitoring and immediate supportive care are paramount to managing this life-threatening complication.

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