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The Impact of Acute Renal Failure on Treatment-Related Toxicity and Resource Utilization in Patients Undergoing CAR T-Cell Therapy for Diffuse Large B-Cell Lymphoma: A Nationwide Study

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Abstract

Background

Acute renal failure (ARF) is a potential complication in patients receiving chimeric antigen receptor (CAR) T-cell therapy for diffuse large B-cell lymphoma (DLBCL). While associations with cytokine release syndrome (CRS) and immune effector cell-associated neurotoxicity syndrome (ICANS) have been described, the broader cardiovascular, infectious and economic consequences of ARF in this setting remain insufficiently delineated. We assessed the national impact of ARF on mortality, organ dysfunction, infections, immune-effector toxicity and resource utilization.

Methods

Adult DLBCL hospitalizations receiving CAR T-cell therapy were obtained from the National Inpatient Sample (2017–2022) through ICD-10 PCS codes. Patients who developed ARF were identified using ICD-10 codes. Patients with end-stage renal disease or CKD $\geq 3a$ were excluded. Outcomes included in-hospital mortality, CRS (2021–2022), ICANS (2022), hemophagocytic lymphohistiocytosis (HLH), cardiovascular events, infections, and

hospitalization costs. Comparisons were performed using chi-square tests and multivariable regression was performed to adjust for demographics, comorbidities, institutional factors and CRS.

Results

Among 5,235 weighted CAR-T hospitalizations, ARF occurred in 11.6% and was associated with markedly higher inpatient mortality (14.9% vs 1.2%; adjusted OR 16.3, 95% CI 5.6–47.2; $p < 0.001$). ICANS rates were similar (22.2% vs 27.9%; $p = 0.502$). High-grade CRS was more frequent among ARF patients (grade 3: 7.8% vs 1.7%; grade 4: 9.8% vs 0%; both $p \leq 0.004$). After adjustment for CRS in multivariate regression, ARF remained strongly associated with HLH (adjusted OR 8.2; $p = 0.012$), acute myocardial infarction (adjusted OR 6.3; $p = 0.020$), major cardiovascular/cerebrovascular events (adjusted OR 9.7; $p < 0.001$), acute respiratory failure (adjusted OR 7.8; $p < 0.001$), pneumonia (adjusted OR 4.3; $p < 0.001$), sepsis (adjusted OR 5.4; $p < 0.001$), and septic shock (adjusted OR 26.1; $p < 0.001$). Patients who developed ARF were stratified by CRS and there was no significant difference in mortality (14.5% vs 15.8%; $p = 0.875$) with broadly comparable rates of

cardiovascular, respiratory, and infectious complications between the two groups in this subgroup analysis. Hospitalization costs were numerically higher with ARF (\$410,930 vs \$359,218; $p=0.099$).

Conclusion

ARF represents a critical prognostic inflection point in patients with DLBCL receiving CAR

T-cell therapy. Its development is associated with substantially increased mortality, high-grade CRS, HLH, major cardiovascular and infectious morbidity and a trend toward higher resource utilization. Importantly, ARF confers excess risk independent of CRS, underscoring the need for proactive renal-risk assessment and early renal-support strategies to mitigate downstream morbidity and mortality.

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