Abstract – CLINICAL CARDIOLOGY

Title: Cardiovascular Monitoring Protocols during CAR-T Cell Therapy: A Systematic Review of Cardiac Toxicity, Screening Strategies, and Management Frameworks

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Background: Chimeric antigen receptor T-cell (CAR-T) therapy is associated with cardiovascular toxicity, including arrhythmias, left ventricular dysfunction, and hemodynamic instability, frequently in the setting of cytokine release syndrome (CRS). Practices for cardiovascular screening, monitoring, and management remain inconsistent across centers.

Methods: PubMed, EMBASE, the Cochrane Library, and ClinicalTrials.gov were searched from January 2017 through December 2024. Eligible studies were reporting cardiovascular outcomes, cardiac biomarkers, or monitoring protocols in patients receiving FDA-approved or investigational CAR-T therapies. Pooled incidences were estimated using random-effects meta-analysis. Primary outcomes were any cardiovascular toxicity, grade ≥3 cardiac events, and cardiovascular mortality.

Results: 21 studies including 9,847 CAR-T recipients met inclusion criteria. Cardiovascular toxicity occurred in 16.4% of patients. Arrhythmia occurred in 8.2%; cardiomyopathy in 4.6%; and vasopressor-requiring hemodynamic compromise in 3.8%, with some patients experiencing more than one event. Grade ≥3 CRS was associated with cardiac toxicity, as demonstrated by Ganatra

et al. Troponin elevation within 72 hours of infusion was associated with subsequent ventricular dysfunction in four studies. Pre-existing cardiac disease, age >65 years, and prior anthracycline exposure were the most consistently reported risk factors. Six of 21 studies described a standardized pre-infusion cardiovascular assessment. Post-infusion monitoring ranged from no defined protocol to daily troponin measurement with continuous telemetry for 7 days.

Conclusion: About one in six CAR-T recipients experienced cardiovascular toxicity, most often in association with higher-grade CRS. Monitoring practices varied substantially, and few studies reported standardized pre-infusion evaluation. Standardized risk stratification, biomarker surveillance, and evidence-based management pathways may help identify high-risk patients earlier. Prospective studies are needed to determine whether these approaches reduce cardiovascular morbidity and mortality.