Uncovering Immune Escape Mechanisms in CAR-T Therapy for Acute Lymphoblastic Leukemia: A Meta-analysis of Clinical Outcomes

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Introduction

CAR-T therapy is a promising treatment for ALL but resistance emerges due to immune escape. This study evaluates mechanisms of immune evasion and adverse outcomes.

Methods

Design

Systematic review & meta-analysis (PRISMA 2020)

Databases

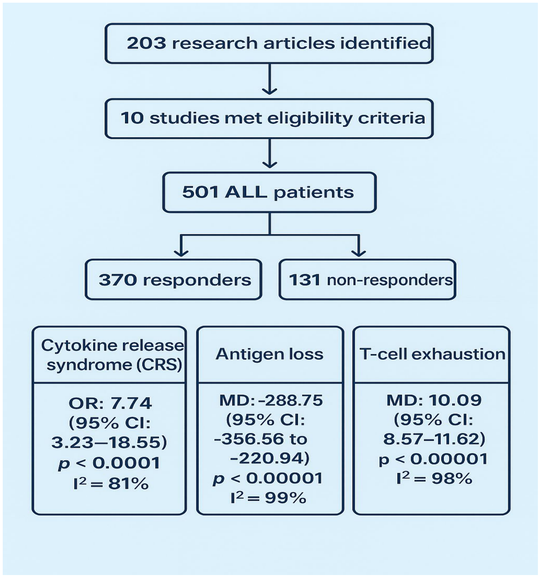
PubMed · Cochrane Library · MEDLINE (to Dec 2024)

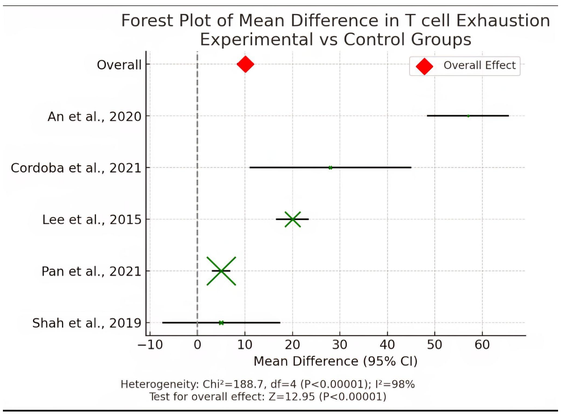
Eligibility

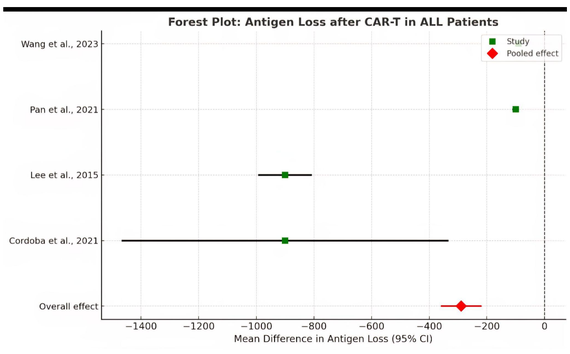
- **Inclusion:** Phase I/II trials of CAR-T in ALL with immune escape outcomes
- **Exclusion:** Case reports, reviews, preclinical studies, non-extractable data

Analysis

- Random-effects model (RevMan v5.4.0)
- Outcomes: Antigen loss · T-cell exhaustion · Cytokine release syndrome
- Effect size: OR/MD with 95% CI
- Heterogeneity: I^2 statistic
- Subgroup: Pediatric vs Adult
- Publication bias: Funnel plot







Results

Analysis revealed that cytokine release syndrome (CRS), antigen loss and T-cell exhaustion were significantly higher among non-responders after CAR-T therapy.

Subgroup analysis revealed that CRS was more pronounced in pediatric patients [OR: 9.58 (95% CI: 3.79–24.25), compared to adults [OR: 4.41 (95% CI: 0.58–33.81),

Conclusion

This meta-analysis reveals that the effectiveness of CAR T-cell therapy in patients with Acute Lymphoblastic Leukemia (ALL) is limited by resistance mechanisms, including antigen loss, T-cell exhaustion, and adverse events such as cytokine release syndrome, all of which contribute to treatment failure and relapse.