Allogeneic Hematopoietic Cell Transplantation After CAR-T Cell Therapy in B-Cell Acute Lymphoblastic Leukemia: A Meta-Analysis of Survival and Relapse Outcomes

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Context

Clinical context
CAR-T therapy produces high remission rates in R/R B-ALL, but remission durability remains a major challenge in adults.

Why this study
The role of consolidative allo-HCT after CAR-T therapy remains uncertain.

Objective
Evaluate survival and relapse outcomes with allo-HCT consolidation after CAR-T therapy in R/R B-ALL.

Study design

Systematic review and meta-analysis

- Comparative allo-HCT versus no-transplant studies
- Major electronic databases
- Time-to-event outcomes after CAR-T therapy

Methods

Eligibility
- R/R B-ALL treated with CAR-T therapy
- Reported or estimable HRs with 95% CIs for OS, LFS, or relapse

Outcomes
- **Primary:** OS and LFS
- **Secondary:** relapse

Synthesis
- Inverse-variance pooling
- Fixed-effects model for OS
- Random-effects models for LFS and relapse

Heterogeneity
- I^2 statistic and leave-one-out sensitivity analysis for LFS

Evidence base
- OS: 3 studies; LFS: 5 studies; relapse: 2 studies

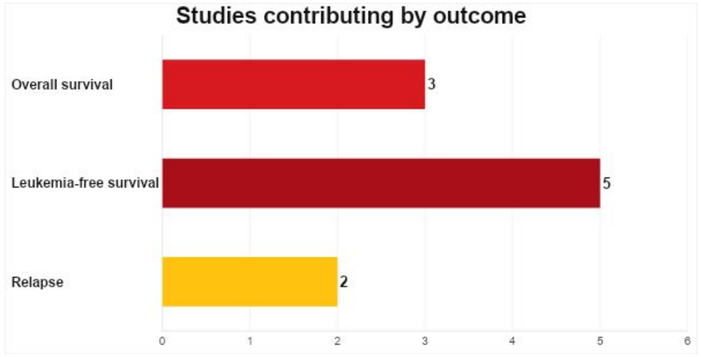

Figure 1. Five studies contributed to the LFS analysis.

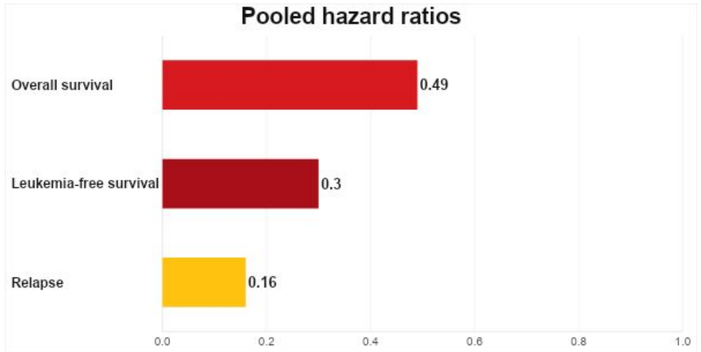

Figure 2. HR below 1.0 favored consolidative allo-HCT.

3 / 5 / 2
studies
OS / LFS / relapse

80.9%
I^2 for LFS
sensitivity estimate robust

Primary finding: allo-HCT favored OS, LFS, and relapse.

Pooled outcomes
allo-HCT versus no transplantation

Outcome	Pooled HR (95% CI)	p value	I^2
OS	0.49 (0.33-0.72)	0.0004	0%
LFS	0.30 (0.16-0.55)	0.0001	80.9%
Relapse	0.16 (0.10-0.23)	<0.001	0%

All pooled HRs favored allo-HCT

Sensitivity analysis
Pooled LFS remained robust; I^2 resolved after excluding one methodologically distinct study.

Key finding
Consolidative allo-HCT after CAR-T was associated with improved OS, LFS, and relapse outcomes.

Pooled HRs: OS 0.49 | LFS 0.30 | Relapse 0.16

Results

- **OS (3 studies):** HR 0.49 (95% CI 0.33-0.72); p=0.0004.
- **LFS (5 studies):** HR 0.30 (95% CI 0.16-0.55); p=0.0001.
- **Relapse (2 studies):** HR 0.16 (95% CI 0.10-0.23); p<0.001.
- **Heterogeneity:** I^2=0% for OS and relapse; I^2=80.9% LFS
- **Sensitivity:** the pooled LFS estimate remained robust.

Interpretation
All three pooled outcomes favored allo-HCT consolidation after CAR-T therapy.

Conclusions

- Allo-HCT consolidation after CD19-directed CAR-T therapy was associated with improved survival and relapse outcomes.
- It may benefit selected patients in remission; prospective studies should define patient selection and treatment sequencing.

Data source & abbreviations

Data: Systematic review and meta-analysis of comparative studies. CAR-T, chimeric antigen receptor T-cell therapy; allo-HCT, allogeneic hematopoietic cell transplantation; R/R B-ALL, relapsed/refractory B-cell acute lymphoblastic leukemia; OS, overall survival; LFS, leukemia-free survival; HR, hazard ratio; CI, confidence interval; I^2, heterogeneity statistic.

Clinical implication: consider allo-HCT consolidation in selected patients achieving remission after CD19 CAR-T.