

4th Cuneo City ImmunoTherapy Conference (CCITC)

Immunotherapy in Hematological Malignancies **2024**

CUNEO

October 10-12, 2024

Spazio Incontri Fondazione CRC



CAR-T in AML: ready for prime time?

Sarah Tettamanti, PhD

Tettamanti Center, Fondazione IRCCS San Gerardo dei Tintori, Monza, Italy

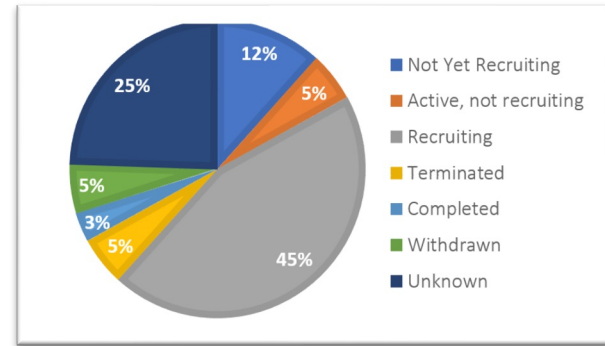
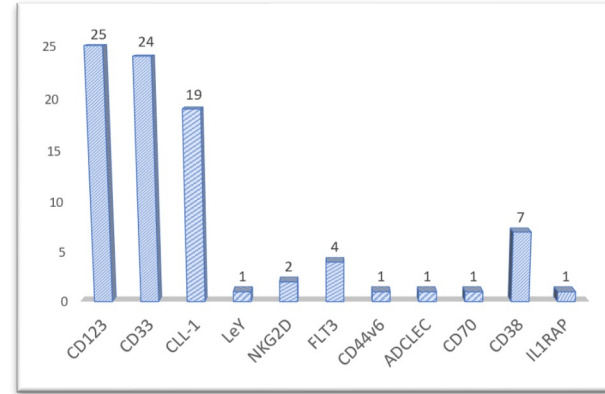
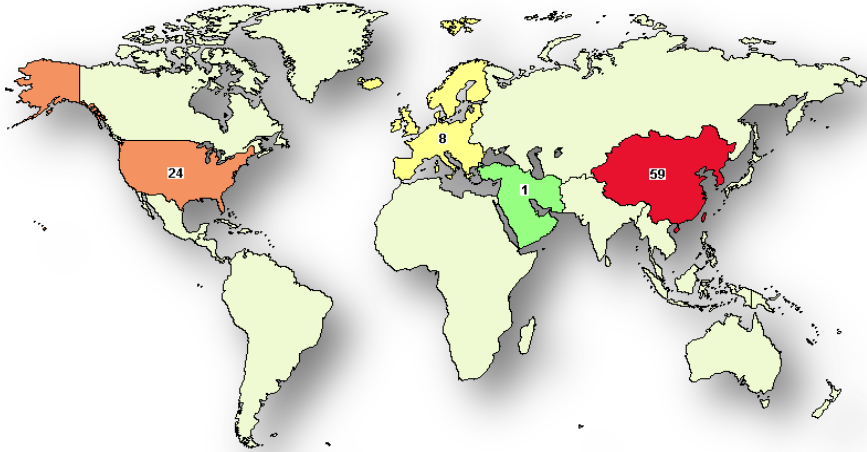
Organized by Prof. Massimo Massaia, SC Ematologia AO S.Croce e Carle, Cuneo - Italy and
Centro Interdipartimentale di Biotecnologie Molecolari "Guido Tarone" (MBC), Torino - Italy

Immunotherapy in Hematological Malignancies 2024

Disclosures of Sarah Tettamanti

Company name	Research support	Employee	Consultant	Stockholder	Speakers bureau	Advisory board	Other
N/A							

CAR T cells in AML: clinical trials



ClinicalTrials.gov Search Results 13/02/2024

CAR T cells in AML: clinical trials

- Active trials

NCT Number	Interventions	Study Title	Sponsor
NCT03927261	PRGN-3006 T Cells	PRGN-3006 Adoptive Cellular Therapy for CD33-Positive Relapsed or Refractory AML, MRD Positive AML or Higher Risk MDS	Precigen, Inc
NCT02159495	Autologous CD123CAR-CD28-CD3zeta-EGFRt	Genetically Modified T-cell Immunotherapy in Treating Patients With R/R AML and Persistent/Recurrent BPDCN	City of Hope Medical Center
NCT03766126	CART123 cells	Lentivirally Redirected CD123 Autologous T Cells in AML	University of Pennsylvania

CAR T cells in AML: clinical trials

Recruiting trials

NCT Number	TARGET	Interventions	Sponsor
NCT05748197	ADLEC	ADLEC.syn1 CAR T cells	Memorial Sloan Kettering Cancer Center
NCT05457010	ARC	ARC-T Cells	Arcellx, Inc.
NCT06118788	BG1805	BG1805	Guangzhou Bio-gene Technology Co., Ltd
NCT06420063	CD123	CD123/CD33 CAR T	Essen Biotech
NCT04318678	CD123	CD123-CAR T	St. Jude Children's Research Hospital
NCT04265963	CD123	CD123 CAR-T cells	Chongqing Precision Biotech Co., Ltd
NCT04272125	CD123	CD123 CAR-T cells	Chongqing Precision Biotech Co., Ltd
NCT06006403	CD123	CD123 CAR-NK cells	Chongqing Precision Biotech Co., Ltd
NCT04678336	CD123	CART123 cells	University of Pennsylvania
NCT04230265	CD123	UCART + TMCDD123	AvenCell Europe GmbH
NCT03190278	CD123	UCART123v1.2	Cellectis S.A.
NCT05949125	CD123	DRUG: R-TM123 DRUG: Allo-RevCAR01-T	AvenCell Europe GmbH
NCT04257175	CD19	CAR-T CD19	Sheba Medical Center
NCT03896854	CD19	CART-19	Shanghai Unicar-Therapy Bio-medicine Technology Co.,Ltd
NCT05942599	CD33	BE CAR33 T Cells (BE752TBTBCAR33PBL)	Great Ormond Street Hospital for Children NHS Foundation Trust
NCT05672147	CD33	CD33 CAR T-cells	City of Hope Medical Center
NCT05984199	CD33	VCAR33	Vor Biopharma
NCT05945849	CD33	CD33KO-HSPC; CART33	University of Pennsylvania
NCT05665075	CD33	CD33CAR NK	Zhejiang University
NCT05105152	CD33	SC-DARIC33	Seattle Children's Hospital
NCT03971799	CD33	CD33CART autologous	Center for International Blood and Marrow Transplant Research
NCT06017258	CD371	CD371-specific/5MVz/-18 CAR T cells	Memorial Sloan Kettering Cancer Center
NCT05239689	CD38	CD38 CAR T-cells	Zhejiang University
NCT05442580	CD38	CART-38 cells	University of Pennsylvania
NCT06197672	CD4	CD4CAR	Huda Salman
NCT06326463	CD70	CD70-CAR T cell	St. Jude Children's Research Hospital
NCT05454241	CD70	CD7 CAR-T	Ying Wang
NCT05995028	CD70	Universal CD7-specific CAR gene-engineered T cells	Shenzhen Geno-Immune Medical Institute
NCT04662294	CD70	CD70 CAR T-cells	Zhejiang University
NCT05377827	CD70	CD7 Allogeneic CAR T-Cells	Washington University School of Medicine
NCT05266950	Cl-135	Cl-135 CAR-T cells	Beijing Boren Hospital
NCT05252572	CLL1	CLL1 CAR T-cells	Zhejiang University
NCT06307054	CLL1	CLL-1 CAR NK cells	Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine
NCT04219163	CLL1	CLL-1 CAR T cells	Baylor College of Medicine
NCT04923919	CLL1	CLL1 CART cells	320th Hospital of Joint Logistics Support Force of People's Liberation Army of China
NCT06110208	CLL1	CLL1 and CD38 dual-target CAR-T injection	320th Hospital of Joint Logistics Support Force of People's Liberation Army of China
NCT04884984	CLL1	CLL1 CART	The First Affiliated Hospital of Soochow University
NCT06128044	CLL1	CLL1 CAR T	Caribou Biosciences, Inc.
NCT05995041	CLL1, CD33, CD38, CD123	CLL-1, CD33, CD38 and/or CD123-specific universal CAR- T cells	Shenzhen Geno-Immune Medical Institute
NCT06492304	CTX131	CTX131	CRISPR Therapeutics
NCT04167696	CYAD	CYAD-02	Celyad Oncology SA
NCT06326021	FL-33	autologous FL-33 CAR T	Beijing GoBroad Hospital
NCT05023707	FLT3	FLT3 CAR-T	The First Affiliated Hospital of Soochow University
NCT05445011	FLT3	FLT3 CAR T	Wuhan Union Hospital, China
NCT05432401	FLT3	FLT3 CAR T	PersonGen BioTherapeutics (Suzhou) Co., Ltd.
NCT04803929	ILT3	ILT3 CAR-T	Carbiogene Therapeutics Co. Ltd.
NCT05488132	SIGLEC 6	Siglec-6 CAR-T cells	Kuzhou Medical University
NCT05017883	TAA05	TAA05 cell injection	PersonGen BioTherapeutics (Suzhou) Co., Ltd.
NCT06125652	TIM-3/CD123	Tim-3/CD123 CAR-T cell	Kuzhou Medical University
NCT03291444		CAR T cells BIOLOGICAL: peptide specific dendritic cell	Zhujiang Hospital

First wave of Anti-AML CARs in clinic: 2013-2022

AML clinical results – published & abstracts

Agent	Patients	Responses	Toxicity	Correlatives
CD123				
Donor CART123 ¹	1	PR (7)	CRS gr. 4	Not reported
UniCART-123 ²	3	1 PR, 2 CRi	CRS gr.1 n = 2. Myelosuppression.	Expansion, persistence. IL6/TNF/IFNy
CART-123 ³	7 (18 enrolled)	2 MLFS, 1 CRi	CRS gr.1-2.	Peak expansion DM. No CD123 loss.
CD33				
UltraCART-33 ⁴	9 (no LD) 6 (with LD)	ORR = 3, 2 early relapse and 1 bridged to allo	CRS gr. 1-3 n = 7	Undetectable increase in cytokines. Mean VCN 1.1×10^4 (no LD) vs 1.2×10^3 (LD cohort)
CART-33 ⁵	1	PR	CRS, pancreatitis	IL6/IL8/TNF/IFNy. Peak VCN = 1×10^5
CART-33 ⁶	3	0	CRS, pancreatitis (1)	IL6/TNF/IFNy elevation
CLL-1 (CLEC12A)				
CART-CLL1 ⁷ (pediatric)	8	1 CRi (MRD+ve), 1 MLFS (MRD+ve), 1 CRi (MRD+ve), 1 PD, 1 SD	CRS gr. 1-2 n = 8	Not reported
CLL1/CD33 CART ⁸	11	8 CR, 1 PR	CRS gr. 1-3 n = ?	Not reported
CART-CLL1 ⁹	10	7 CR/CRi, 6 underwent HSCT at median 20d post CART	CRS mild (4); severe (6). Severe pancytopenia (10)	IL6 elevation

¹ Yao Front Oncol 2019;9:1358
² Wermke Blood 2021

³ Budde AACR 2020
⁴ Salzman ASH 2021

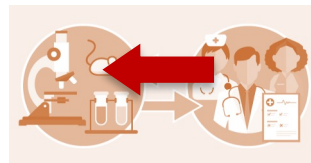
⁵ Wang Mol Ther 2014
⁶ Tambaro Leukemia 2021

⁷ Zhang Leukemia 2022
⁸ Zhang ASCO 2021

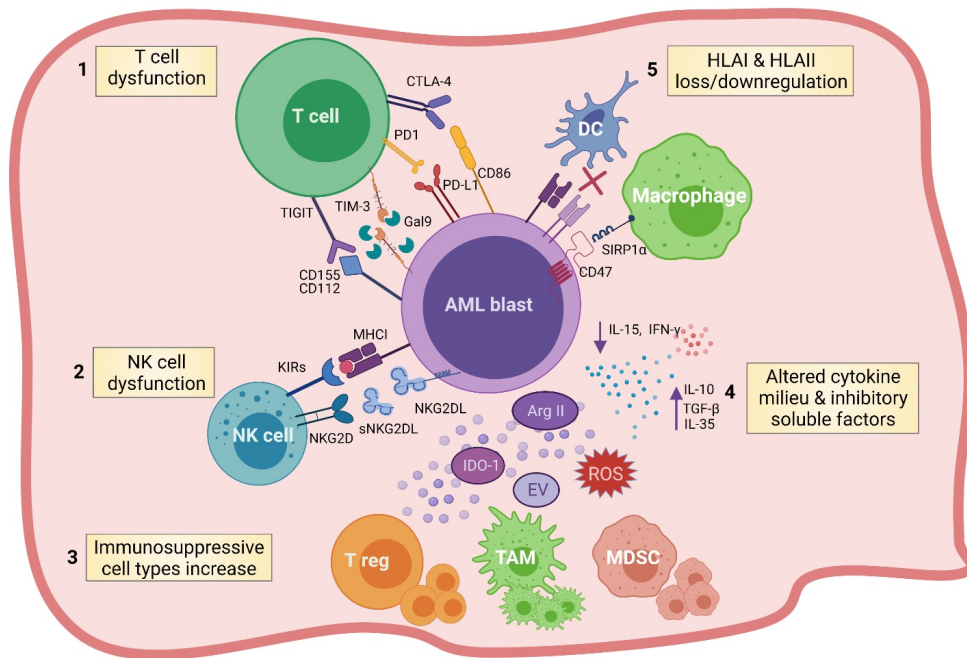
⁹ Jin J. Heme Onc 2022

~30% response rate

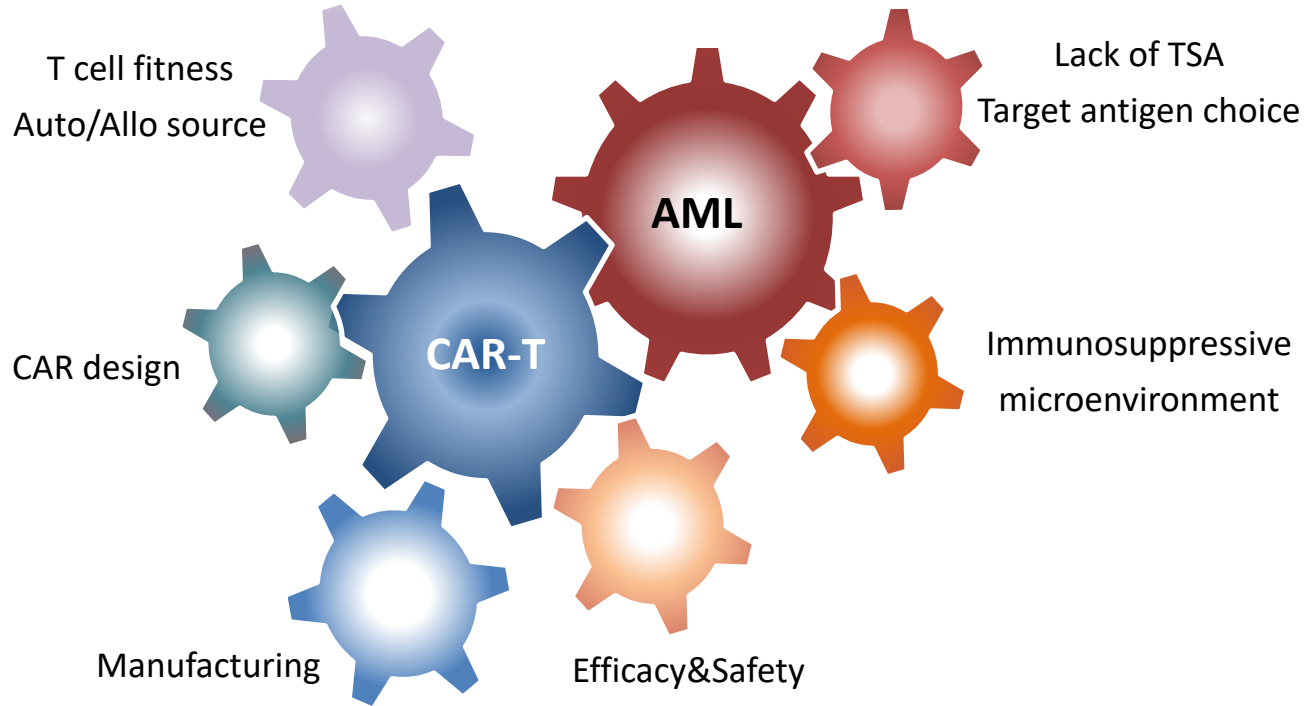
Limited persistence
&
Activity
↓
Why?



The bone marrow AML niche: the sanctuary of LSCs



Challenges in CAR T cell therapy for AML



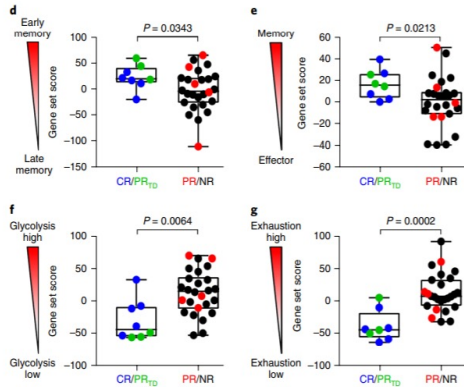


T Cell Fitness and Autologous CAR T Cell Therapy in AML

nature medicine LETTERS
November 2020 | Volume 16 | Number 11 | 1187-1191

Determinants of response and resistance to CD19 chimeric antigen receptor (CAR) T cell therapy of chronic lymphocytic leukemia

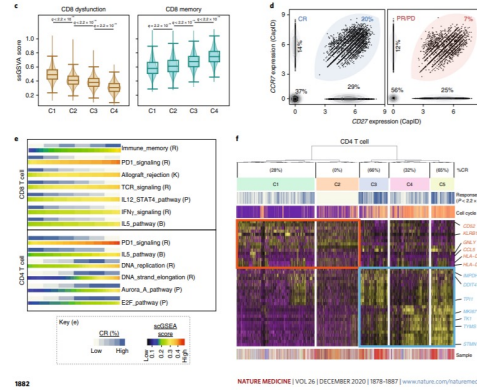
Joseph A. Fraietta^{1,2,3}, Simon F. Lacey^{1,2,3}, Elena J. Orlando^{1,2,3}, Julian Prokham-Malkin^{1,2,3}, Mercy Goh^{1,2,3}, Stefan Lindt^{1,2,3}, Alisa C. Brennan^{1,2,3}, Yan Wang^{1,2,3}, Robby S. O'Connor^{1,2,3}, Wei-Ting Huang^{1,2,3}, Edward Popplewell^{1,2,3}, David E. Anderson^{1,2,3}, Chengzeng Zhang^{1,2,3}, Nicholas Wilford^{1,2,3}, Felipe Botana^{1,2,3}, Caitin Dorfman^{1,2,3}, Fang Chen^{1,2,3}, Lilong Tian^{1,2,3}, Hari Parvathani^{1,2,3}, Miral Gupta^{1,2,3}, Regina M. Young^{1,2,3}, E. Brad Johnson^{1,2,3}, Uma Kallambakar^{1,2,3}, Li-Li Lu^{1,2,3}, Sadi K. Karim^{1,2,3}, Akshay M. Chaudhry^{1,2,3}, Bruce L. Levine^{1,2,3}, Nicole V. Frey^{1,2,3}, Donald L. Siegel^{1,2,3}, Alexander C. Huang^{1,2,3}, E. John Wherry^{1,2,3}, Hans Ottler^{1,2,3}, Jennifer L. Brinkman^{1,2,3}, David L. Porter^{1,2,3}, Carl H. June^{1,2,3} and J. Joseph Michon^{1,2,3}



ARTICLES nature medicine
November 2020 | Volume 16 | Number 11 | 1192-1207

Characteristics of anti-CD19 CAR T cell infusion products associated with efficacy and toxicity in patients with large B cell lymphomas

Qing Deng^{1,2}, Guangchun Han^{1,2,3}, Nahom Fushie Olorun^{1,2}, Man Chen Juhn Ma^{1,2}, Paolo Strati^{1,2}, Beth Chasen^{1,2}, Enyu Dai^{1,2}, Minghao Dang^{1,2}, Neeraj Jain^{1,2}, Haoping Yang^{1,2}, Yuanshi Wang^{1,2}, Shaolin Zhang^{1,2}, Ruijing Wang^{1,2}, Kunzhe Chen^{1,2}, Jordan Shewell^{1,2}, Srinivas Ghosh^{1,2}, Sindee Patchva^{1,2}, Qi Zhang^{1,2}, Ryan Surr^{1,2}, Frederic Hagmann^{1,2}, Luis Fayez^{1,2}, Felipe Santambrogio^{1,2}, Hans C. Lee^{1,2}, Loretta J. Nathoo^{1,2}, Nathan Fowler^{1,2}, R. Eric Davis^{1,2}, Jason Westler^{1,2}, Sethra S. Neelapu^{1,2}, Linghua Wang^{1,2} and Michael R. Green^{1,2,3}



CD33CAR

NCT03126864

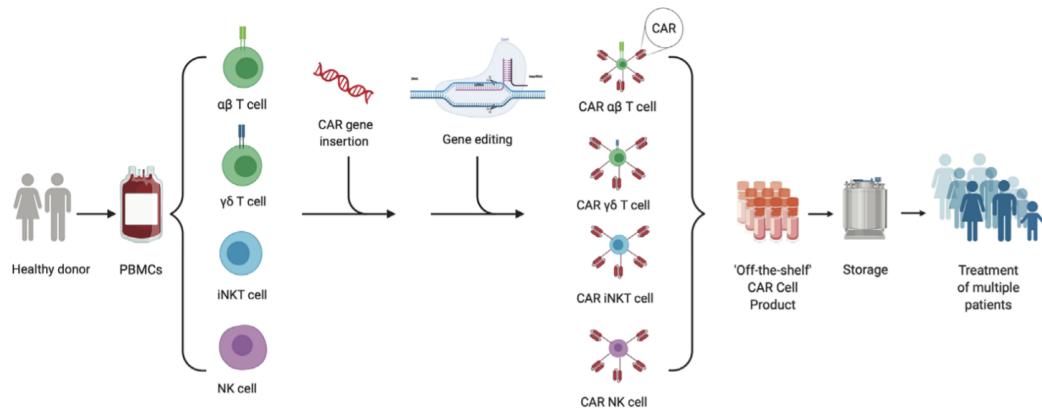
University of Texas MD Anderson Cancer Center

- 10 R/R AML pts enrolled, **only 3** pts treated
- Second generation CAR (41BB), autologous T cells
- All three patients who received CD33-CAR-T cells have died, due to disease progression; study closed;
- The sponsors have transitioned to a platform that facilitates **more rapid production and in vivo expansion** with a product referred to as PRGN-3006 (NCT03927261)

Quality of CAR T cell product → CLINICAL RESPONSE



Allogeneic source

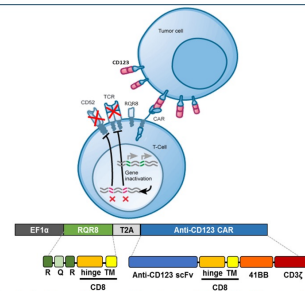


CD123 CAR-adult, multicentric phase I, United States

- AMELI-01
- Allogeneic UCART-123v1.2 (41BB)
- FC or FCA (**Alemtuzumab**) lymphodepleting regimen (8pts + 8 pts)
- FCA regimen → improved LD and significantly higher UCART123v1.2 cell expansion
- 1 pt in the DL2 (6.25x10⁵ cells/kg) FCA arm achieved >90% blast reduction at Day 28
- 1 pt in the DL2 FCA arm achieved a long term durable MRD negative CR (now past 12 months)
- Based on observed UCART123v1.2 expansion patterns and cytokine profiles, **the study will be enrolling patients in the FCA 2-dose regimen arm (DL2)**

UCART123v1.2 (anti-CD123 scFv-41BB-CD3ζ):

- CD123 is a validated therapeutic target in AML
- Genetically modified allogeneic T-cell product manufactured from non-HLA-matched healthy donor cells
- TRAC disrupted using TALEN® to eliminate TCRαβ from the cell surface and reduce risk of GvHD
- CD52 disrupted using TALEN® to eliminate sensitivity to LD with alemtuzumab





Allogeneic source

Switch on/off system: **UniCAR T cells**

ASH 2022:

N=14

CRS 12/14

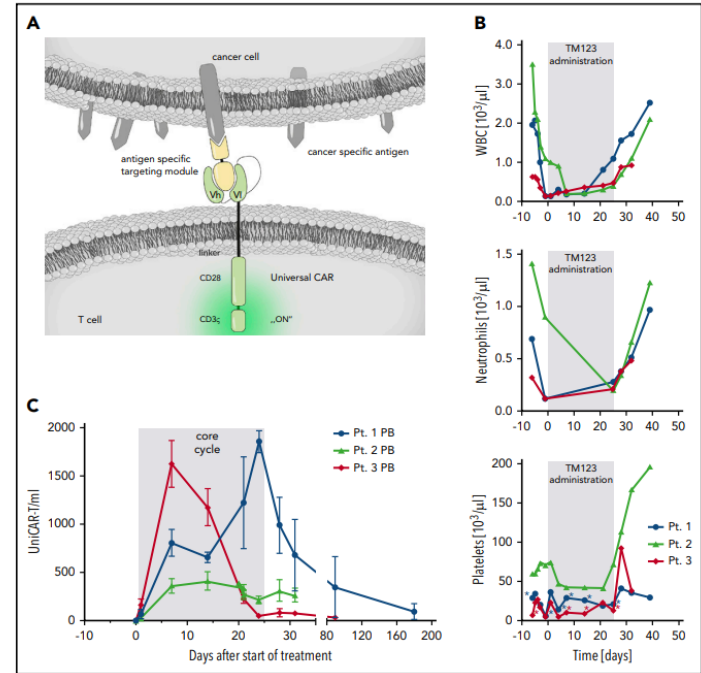
4 PR, 2 CRi, 1 CR

Allogeneic CD123-Directed Switchable CAR-T



NCT05949125

AVC-201 is the world's first CRISPR-engineered switchable allogeneic CAR-T designed to fully avoid rejection by both the innate and adaptive host immune system.



Wermke et al., *Blood* 2021;



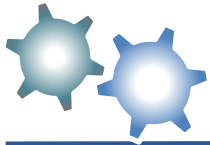
CAR NK Cell Therapy in AML

Table 4. Completed CAR-NK cell clinical studies with reported outcomes in relapsed/refractory acute myeloid leukemia. PD: progressive disease, CR: complete response, RD: relapsed disease, PB: peripheral blood, N/A: information not available.

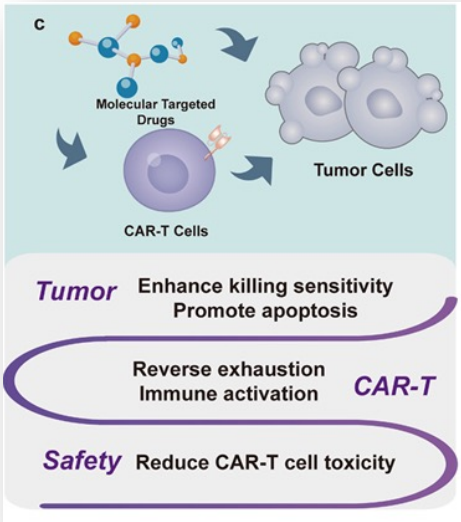
Target Antigen	Phase	NK Cell Source	CAR Construct/Genetic Modifications	Reported Outcomes
CD33	I	NK92	[62] Tang et al.: N/A	3/3 PD.
	I	PB	[89] Huang et al.: N/A	4/10 PD, 4/10 RD after CR, 2/10 CR

Table 5. Active/recruiting CAR-NK cell trials in acute myeloid leukemia. r/r: relapsed/refractory, AML: acute myeloid leukemia, MDS: myelodysplastic syndrome, iPSCs: induced pluripotent stem cells.

NCT Identifier	Phase	NK Cell Source	Target Antigen	CAR Construct/Genetic Modifications	Disease	Location
NCT05574608	I	Unknown	CD123	Unknown CAR design	r/r AML	The 5th Medical Center of Chinese PLA General Hospital, Beijing, China
NCT05215015	I	Unknown	CD33, CLL-1	Unknown CAR design	r/r AML	Wuxi People's Hospital, Wuxi, China
NCT04623944 [90]	I	Peripheral blood of haplo-matched, related, or unrelated donors	NKG2D ligands	NKG2D-OX40-CD3ζ <u>Additional modification</u> membrane-bound IL15	- r/r AML - intermediate, high and very high-risk r/r MDS	Multicenter, Nkarta Inc., San Francisco, CA, USA



Molecular targeted drugs & CAR T cells



Dasatinib + CD123CAR T pediatric- St.Jude Children's Research Hospital, **United States**

- Bridge to allo-HSCT Phase 1 study
- Lenti-CD123-CD28 CAR and a CD20 safety switch, autologous CD4/CD8 T cells
- Upcoming CD123-CAR T cell products will be manufactured in the presence of **dasatinib** to limit T-cell differentiation and exhaustion

Azacitidine

ARTICLE

<https://doi.org/10.1038/s41467-021-26483-0>

OPEN

Check for updates

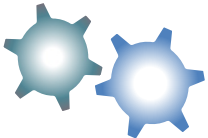
Demethylating therapy increases anti-CD123 CAR T cell cytotoxicity against acute myeloid leukemia

Nadia El Khawanky^{1,2,3,4}, Amy Hughes², Wenbo Yu⁵, Renier Myburgh⁶, Tony Matschulla⁷, Sanaz Taromi^{8,9}, Konrad Aumann⁹, Jade Clarkson¹⁰, Janaki Manoja Vinnakota², Khalid Shoumariyeh³, Cornelius Miething², Angel F. Lopez^{2,5}, Michael P. Brown^{2,5,11}, Justus Duyster², Lutz Hein², Markus G. Manz⁶, Timothy P. Hughes^{12,10}, Deborah L. White^{12,10}, Agnes S. M. Yong^{12,13,14,16} & Deborah Talcott^{3,15,16}

HDAC inhibitors

Chimeric Antigen Receptor T Cells Targeting NKG2D-Ligands Show Robust Efficacy Against Acute Myeloid Leukemia and T-Cell Acute Lymphoblastic Leukemia

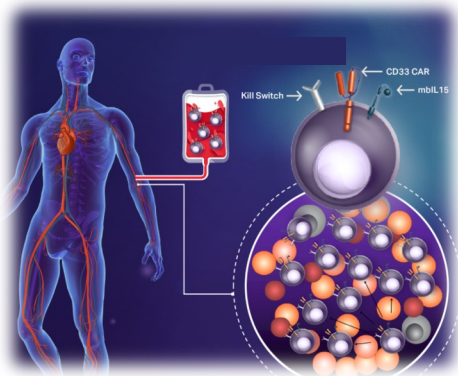
Lina Driouk¹, Joanina K. Gicobi¹, Yusuke Kamihara¹, Kayleigh Rutherford², Glenn Dranoff³, Jerome Ritz^{1,4} and Susanne H. C. Baumeister^{1,4,5,6*}



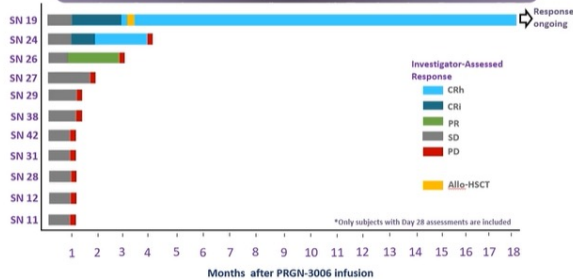
“Fast” CAR T cells in AML

Manufactured Overnight for Next Day Infusion

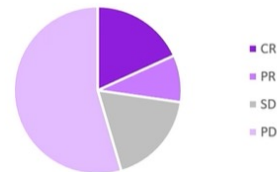
A single infusion of PRGN-3006 led to objective responses in AML patients



PRGN-3006 Infusion resulted in Objective Response Rate of 27% in AML patients



PRGN-3006 Infusion resulted in Objective Response Rate of 27% in AML patients



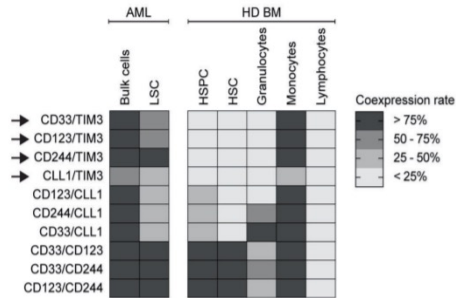
NCT03927261



Dual CAR combinatorial strategies to gain specificity and safety

Coexpression profile of leukemic stem cell markers for combinatorial targeted therapy in AML

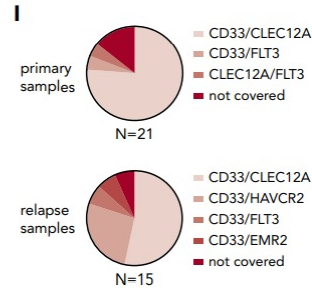
S. Haubner^{1,2,3} · F. Perna³ · T. Köhnke^{1,2} · C. Schmidt^{1,2} · S. Berman³ · C. Augsberger^{1,2} · F. M. Schnorfeil^{1,2} · C. Krupka^{1,2} · F. S. Lichtenegger^{1,2} · X. Liu^{1,2} · P. Kerbs^{1,4,5} · S. Schneider¹ · K. H. Metzeler¹ · K. Spiekermann¹ · W. Hiddemann¹ · P. A. Greif^{1,4,5} · T. Herold¹ · M. Sadelain³ · M. Subklewe^{1,2,4,5}



IMMUNOBIOLOGY AND IMMUNOTHERAPY

CLEC12A and CD33 coexpression as a preferential target for pediatric AML combinatorial immunotherapy

Sergio Willier,¹ Paula Rothamel,¹ Maximilian Hastreiter,¹ Jonas Wilhelm,¹ Dana Stenger,¹ Franziska Blaschke,¹ Meino Rohlf,¹ Theresa Kaeuferle,¹ Irene Schmid,¹ Michael H. Albert,¹ Vera Binder,¹ Marion Subklewe,^{1,2} Christoph Klein,^{1,2} and Tobias Feuchtinger¹



Dual CARs: first clinical data



EHA 2020

FIRST-IN-HUMAN CLL1-CD33 COMPOUND CAR (CCAR) T CELL THERAPY IN RELAPSED AND REFRACTORY ACUTE MYELOID LEUKEMIA

Fang Liu, Hongyu Zhang, Lihua Sun, Yecheng Li, Shan Zhang, Guangcui He, Hai Yi, Masayuki Wada, Kevin G Pinz, Kevin H Chen, Yu Ma, Yisong Xiong, Yi Su, Yupo Ma

	Age/sex Dx	Prior treatment	BM Blast%	CD33/CLL1 expression	Cytogenetic /molecular	Origin of car-t cells	CAR-T Dose	responses
P1	44/m AML	4 chemo	47%	CD33 ⁺ /CLL1 ⁺	ASXL1,TP53	auto	0.7x10 ⁶ /kg	MRD ⁻
P2	6/f JMML-AML	5 chemo	81%	CD33 ⁺ /CLL1 ⁺	Complex FLT3-ITD	auto	2x10 ⁶ /kg	MRD ⁻
P3	23/F CML AP	3 TKIs for 5 years	1.63%	CD33 ⁺ /CLL1 ⁺	t(9;22) T315mut	auto	1.1x10 ⁶ /kg	MRD ⁻
P4	43/F M2	3 chemo	42%	CD33 ⁺ /CLL1 ⁺	NK FLT3-ITD	auto	2.8x10 ⁶ /kg	MRD ⁻
P5	32/F AML	3 chemo	19%	CD33 ⁺ /CLL1 ⁺	NK MLL	auto	2x10 ⁶ /kg	MRD ⁻
P6	48/F AML	5 chemo	94%	CD33 ⁺ /CLL1 ⁺	t(8;21) AML1/ETO CKIT	auto	1.3x10 ⁶ /kg	MRD ⁻
P7	23/F AML	4 chemo	74%	CD33 ⁺ /CLL1 ⁺	t(8;21) AML1/ETO CKIT	auto	1x10 ⁶ /kg	NR
P8	27/F AML	5 chemo	93%	CD33 ⁺ /CLL1 ⁺	NA MLL AF9	auto	2.3x10 ⁶ /kg	NR
P9	42/f AML	2 chemo	7%	CD33 ⁺ /CLL1 ⁺	T(3;3) RUNX1	MSD donor	3.7x10 ⁶ /kg	MRD ⁻

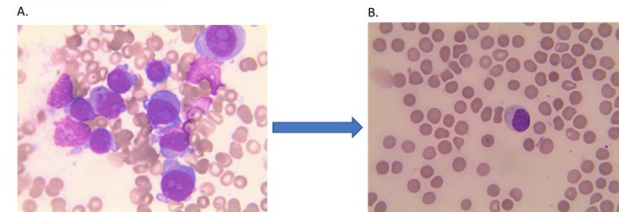


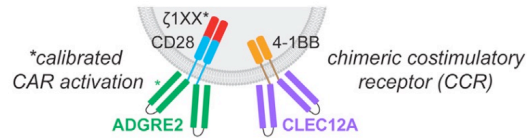
Figure 1. Patient treated with cCAR achieved complete remission. A. 12 days post cCAR infusion, leukemia blasts comprised 98% of the bone marrow. B. 19 days post cCAR infusion, total myeloid ablation had taken place in patient's bone marrow with only CAR T cells existing. Results were confirmed by flow cytometry showing the absence of blasts. Sternal bone marrow aspiration also showed similar findings.

- cCAR carrying two fully equipped CARs (costimulus and CD3z domains)
- All CRS, neurotoxicity and other adverse events were resolved after treatment;
- 7 MRD⁻, 6 underwent HSCT → 5 pts successfully engrafted with a persistent full chimerism (1 died of sepsis before engraftment)

Boolean Logic-gated CARs: IF-better CAR T

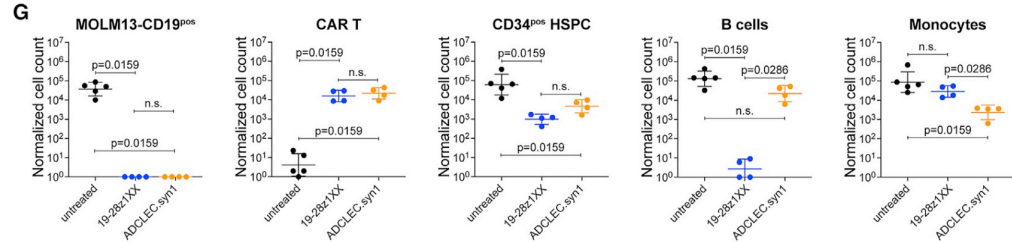
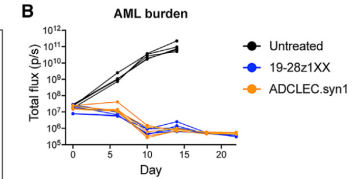
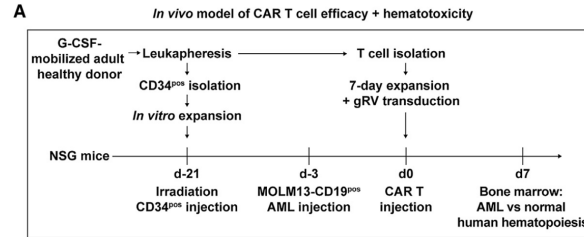
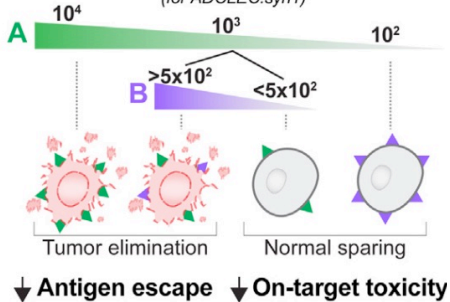


CCR-gated CAR sensitivity: ADCLEC.syn1 for AML



IF-BETTER gate

surface molecules
(for ADCLEC.syn1)



NCT05748197 Memorial Sloan Kettering Cancer Center, USA

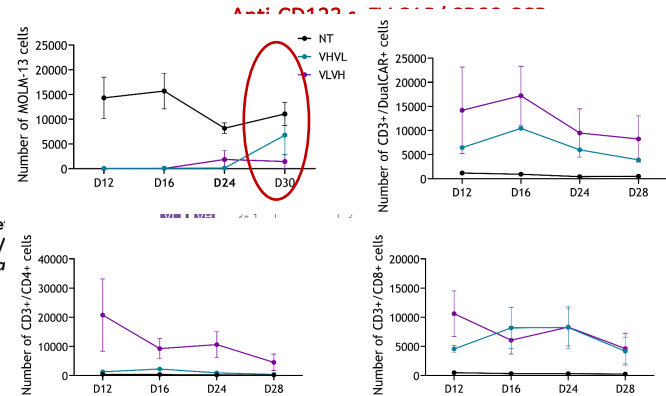
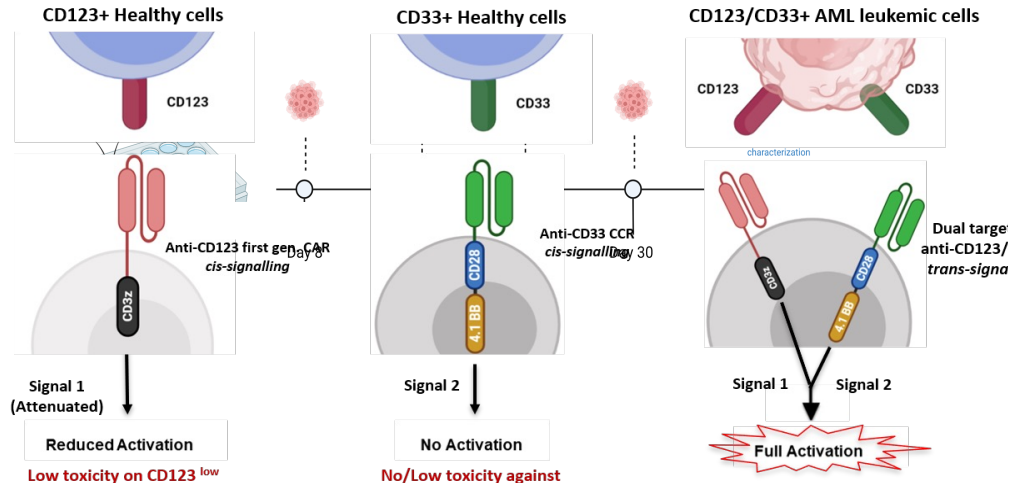
A Phase I Study of ADCLEC.syn1 CAR T cells in Adult Patients with Relapsed or Refractory Acute Myeloid Leukemia

Boolean Logic-gated CARs: Dual AND-gated CD123-CD33 CARCIK cells

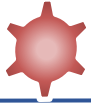


- Split IL3 zetakine CAR and anti-CD33 CCR to improve safety (*Perriello V, Rotiroti M et al., Blood Adv 2022*)
- Ongoing preclinical characterization of scFv derived anti-CD123 CAR (collaboration with Prof. Falini, University of Perugia)

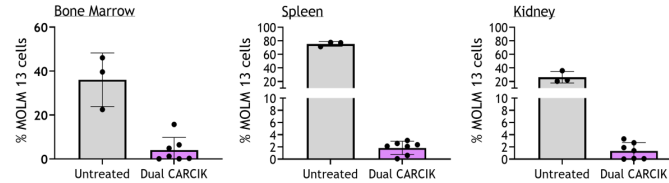
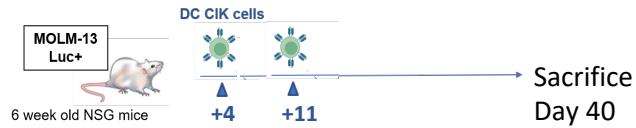
Rechallenge Cytotoxicity Assay



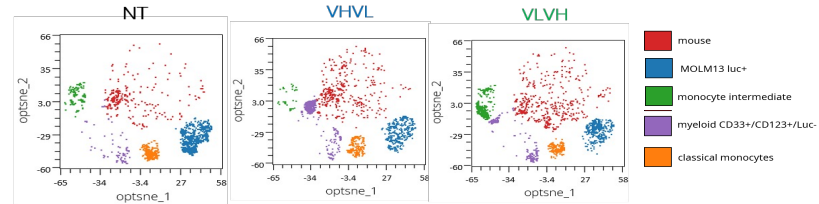
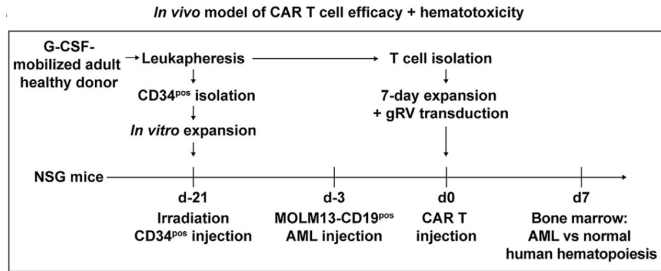
Boolean Logic-gated CARs: Dual AND-gated CD123-CD33 CARCIK cells



- In vivo efficacy of Dual CARCIK cells



- Developing humanized NSG mice model to assess efficacy and toxicity



Non-viral Transposon based CAR-Clk cell engineering

Cytokine-Induced killer (CIK) cells

- Basal antitumor activity
- Low GvHD
- Safe and well tolerated

Introna M et al., Haematologica 2007
Pievani A et al., Blood 2011
Introna M et al., BBMT 2017
Gotti et al., Cytotherapy 2022

Sleeping Beauty transposon system

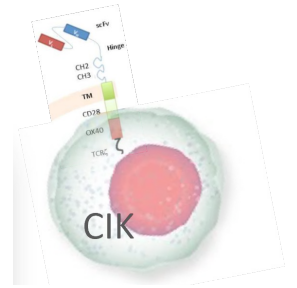
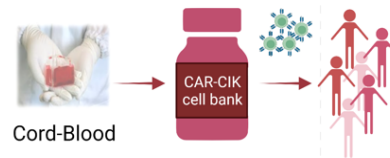
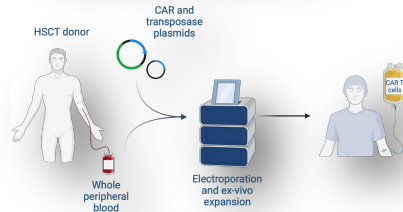
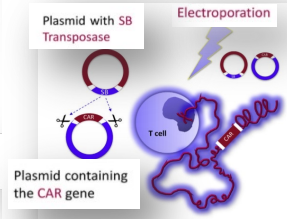
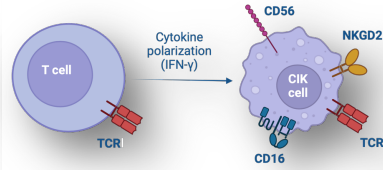
- Random pattern of integration → reduced genotoxicity
- Cost effective

Magnani CF et al., Oncotarget. 2016.
Magnani CF et al., Hum Gene Ther. 2018
Arcangeli S...Tettamanti S et al., Mol Ther 2017
Rotiroli MC...Tettamanti S et al., Mol Ther 2020.

Donor derived cells

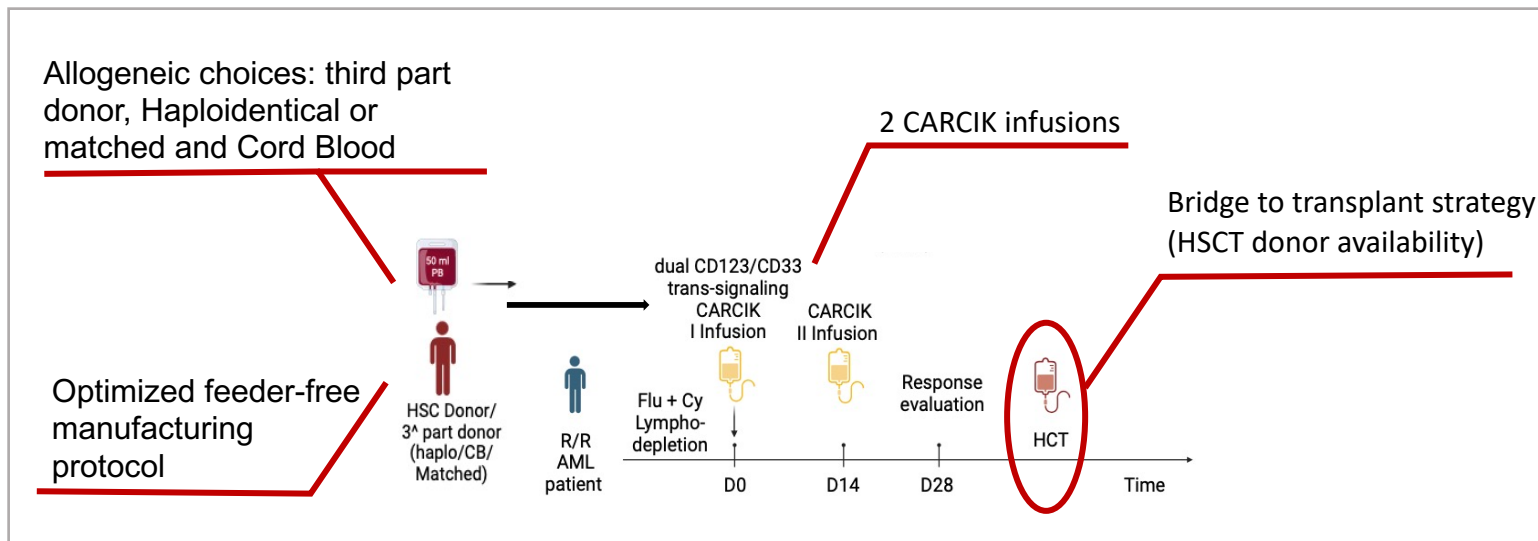
- Healthy T cells

Magnani CF et al., JCI 2020



CD123/CD33 Dual CARCIK from Lab to Clinic: Translating Research into Clinical Trials

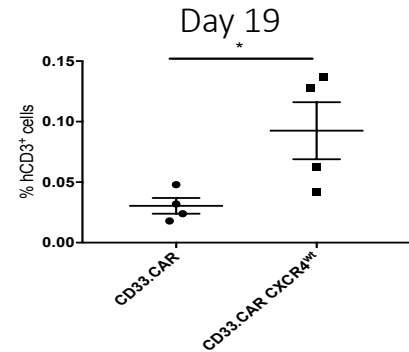
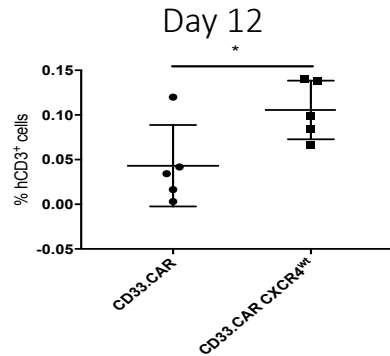
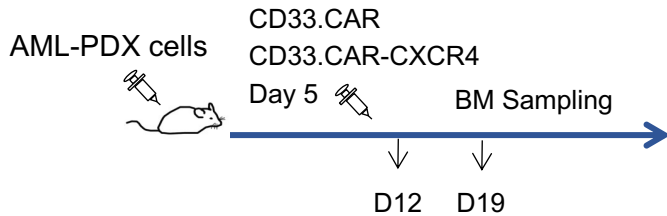
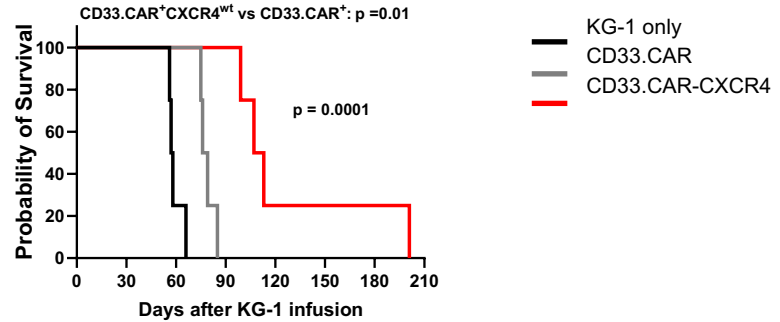
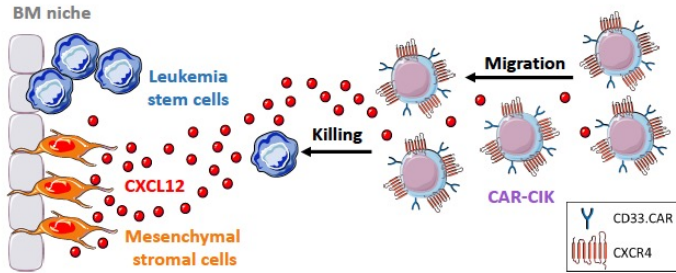
A phase I/II single-arm, clinical trial to evaluate the safety and preliminary efficacy of CD123/CD33 dual CARCIK cell for relapsed/refractory acute myeloid leukemia



Armored CXCR4-CD33 CARCIK cells to boost the homing to the bone marrow niche



Improved antileukemic activity and maximize the presence of CARCIK in the BM in AMLPDX

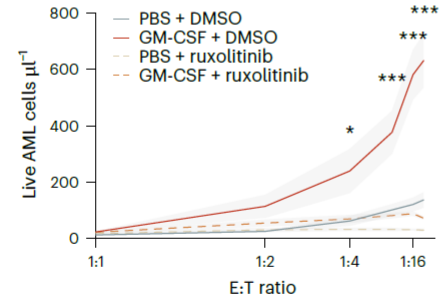
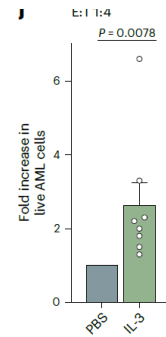
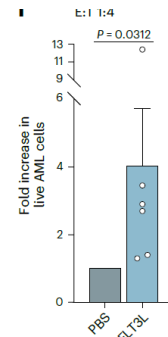
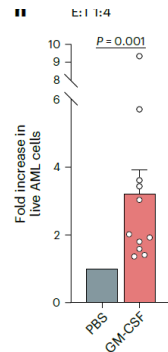
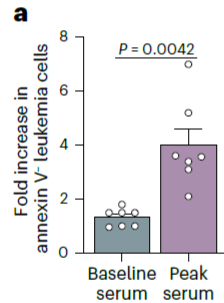
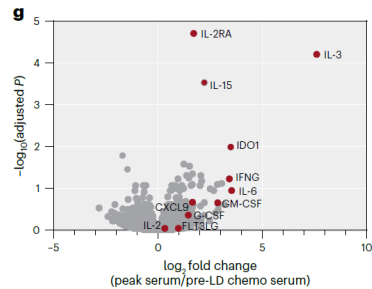
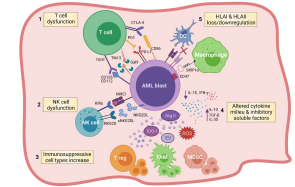


Cytokine-mediated CAR T therapy resistance in AML



Bhagwat A et al., *Nature Medicine* (2024)

- Autologous CD123 CAR T
- 10/12 patients developed CRS
- Of the six patients evaluated for response, 2 CR, 1CRi, and 3 PD
- The overall response rate was 25%.
- The median duration of remission for responding patients: 84 to 381 days, with a median OS from infusion of 160 days.
- Cytokines produced by activated CART cells and other immune cells in the marrow microenvironment stimulated cognate receptors on AML blasts, leading to JAK/STAT signaling, increased blast viability and resistance to CART cell killing



IL-3, GM-CSF, and FLT3L were secreted during the CART-123 therapy, promoting AML blast survival via JAK-STAT signaling.

Conclusions

- **CAR T therapy** can be a **potent immunotherapy approach for AML treatment**
- **Barriers that limit the full therapeutic potential** of CAR T cells (i.e. AML complexity, challenging CAR T manufacture, the cross talk with the immunosuppressive TME)
- The main issues are related to **low CAR T cell persistence and transient anti-leukemic activity**
- **Need to implement anti-AML CAR T therapy with more fit T cells, smarter CARs and combinatorial strategies** → Active preclinical research ongoing (i.e. CD33KO CD34+ or epitope edited CD34+; targeting of the TME)
- Careful and rationally- designed clinical trials are warranted to **increase the therapeutic index of CAR T therapy in AML**

How to foster CAR T cell therapy for AML



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