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Turning tumor inhibition into activation: engineering T cells with chimeric signaling receptors

Ramona Schlenker[1*], Matthias Leisegang[2], Wolfgang Uckert[2,3], Elfriede Noessner[1]

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Poor *in vivo* persistence and loss of function of adoptively transferred T cells in the tumor milieu are known shortcomings of adoptive T cell therapy (ATT). Providing costimulation might help to improve ATT efficiency. However, human CD8 T effector cells are largely CD28 negative and most tumors do not express CD80 or CD86, thus costimulation cannot be provided via CD28 ligation. We propose to facilitate costimulation of CD8 T effector cells in the tumor milieu through engineering of T cells with a chimeric signaling receptor, which can turn tumor mediated inhibition into activation by abrogating inhibitory PD1 signaling with concomitant activation of the costimulatory pathway. Human T cells engineered to express melanoma specific T cell receptors (TCR) plus the chimeric signaling molecule showed higher ERK phosphorylation associated with stronger IL-2 and IFN-γ secretion upon co-culture with PD-L1 positive target cells. T cells expressing a low avidity TCR achieved functional responses comparable to high avidity TCRs when engineered with the chimeric receptor. The chimeric receptor did not only increase cytokine secretion *in vitro*, but importantly, also supported intra-tumoral proliferation of T cells in a humanized mouse melanoma model.

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Authors' details
[1]Institute of Molecular Immunology, Helmholtz Center Munich, German Research Center for Environmental Health, Munich, Germany. [2]Max Delbrück Center for Molecular Medicine, Helmholtz Association, Berlin, Germany. [3]Institute of Biology, Humboldt-University, Berlin, Germany.

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[1]Institute of Molecular Immunology, Helmholtz Center Munich, German Research Center for Environmental Health, Munich, Germany
Full list of author information is available at the end of the article