The Chinese University of Hong Kong
Department of Biomedical Engineering

Mechano-Immunoengineering for Cancer Therapy

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Abstract

Immunotherapy shows great promise for cancer treatment, but its effectiveness and durability remain limited. Thus, there is an unmet need for more robust technology for immune cell engineering. We develop a scalable microfluidic platform to fabricate synthetic viscoelastic activating cells (SynVACs) with programmable mechanical and chemical properties mimicking antigen-presenting cells. We demonstrate that the viscoelastic nature of SynVACs significantly impacts T cell functionality. Compared to rigid or elastic microspheres, SynVACs greatly enhance human T cell expansion with drastic CD8+ T cell generation while suppressing regulatory T cell formation, resulting in enhanced tumor killing capability. Notably, expanding chimeric antigen receptor (CAR)-T cells with SynVACs achieves approximately 90% CAR transduction efficiency and leads to a significant increase of T memory stem cells. These engineered CAR-T cells exhibit superior efficacy in eliminating tumor cells, not only in a human lymphoma mouse model but also in a solid tumor xenograft mouse model of human ovarian cancer. Additionally, SynVAC-expanded CAR-T cells persist for longer periods in vivo to suppress tumor growth and recurrence. These findings underscore the crucial role of mechanical signals in T cell engineering and highlight the potential of SynVAC platform in CAR-T therapy and broad immunoengineering applications.

Biography

Dr. Li holds a B.S. and M.S. from Peking University, as well as a Ph.D. and postdoctoral training in Bioengineering from UC San Diego. Throughout his career, he has held positions with prestige and leadership, including serving as a professor of bioengineering at UC Berkeley from 2001 to 2015, chairing the Bioengineering Department at UC Los Angeles, and serving as the Director of Bioengineering Institute for California. Dr. Li's research is focused on cell and tissue engineering. He has contributed to the understanding of how biophysical factors regulate stem cell differentiation and cell reprogramming, and has developed multidisciplinary approaches for engineering biomaterials, stem cells, and immune cells for tissue regeneration and disease therapy. Dr. Li has published his findings in top scientific journals such as Nature Materials, Nature Biomedical Engineering, Science Translational Medicine, and Advanced Materials. Additionally, he has filed 16 patent applications, co-edited 3 books, and served as the Co-Editor-in-Chief for Med-X Journal. Dr. Li's contributions to bioengineering have earned him numerous awards and honors, including being elected as a Fellow of the American Institute of Medical and Biological Engineering, the Biomedical Engineering Society, and the International Academy of Medical and Biological Engineering.

***** ALL ARE WELCOME *****

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