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Efficient generation of hematopoietic stem cell (HSC)-like cells from human pluripotent stem cells: a platform to create blood and immune cells

Researchers at Stanford have created a method to differentiate human pluripotent stem cells (hPSCs) into >90% pure hematopoietic stem cell (HSC)-like cells, which serve as progenitors to blood and immune cells.

To create any type of human blood or immune cells *in vitro*, hPSCs must first be differentiated into HSC-like cells. Previous differentiation methods yielded heterogeneous cell populations, with HSC-like cells constituting only a small fraction. Also, the resulting HSC-like cells displayed limited expression of key HSC transcription factors.

Stanford researchers devised a system to differentiate hPSCs into >90% pure HSC-like cells that express transcription factors at levels comparable to human HSCs, by involving a transition through an artery intermediate. The resulting hPSC-derived HSC-like cells can be differentiated into a range of blood and immune cell-types, including myeloid cells, erythroid cells, T cells, B cells, and natural killer cells. Replacing diseased blood or immune cells with these engineered cells is a promising treatment approach for many different diseases, including cancers, autoimmune disorders, and genetic diseases. Furthermore, adding new functionalities to these cells could allow for more targeted treatment options.

Stage of Development

Continuing to optimize *in vitro* differentiation of hPSCs into HSC-like cells.

Applications

- Cancers:
  - Leukemia
  - Lymphoma
- Autoimmune disorders:
  - Type I diabetes
  - Multiple sclerosis
- Genetic diseases:
  - Sickle cell anemia
  - Inborn immunodeficiencies
- Blood transfusions
- Disease modeling

Advantages

- >90% pure populations of HSC-like cells capable of upregulating HSC signature transcription factors as opposed to ~3.5% in previous literature.

Publications

- Jonas L. Fowler, Sherry Li Zheng, Alana Nguyen, Angela Chen, Xiaochen Xiong, Timothy Chai, Julie Y. Chen, Daiki Karigane, Allison M. Banuelos, Kouta Niizuma, Kensuke Kayamori, Toshinobu Nishimura, M. Kyle Cromer, David Gonzalez-Perez, Charlotte Mason, Daniel Dan Liu, Leyla Yilmaz, Lucile Miquerol, Matthew H. Porteus, Vincent C. Luca, Ravindra Majeti, Hiromitsu Nakauchi, Kristy Red-Horse, Irving L. Weissman, Lay Teng Ang, Kyle M. Loh (2024), Lineage-tracing hematopoietic stem cell origins in vivo to efficiently make human HLF+ HOXA+ hematopoietic progenitors from pluripotent stem cells. *Developmental Cell*. ISSN 1534-5807.

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