Concise Review: Chemical Approaches for Modulating Lineage-Specific Stem Cells and Progenitors.

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Public Summary:
Generation and manipulation of lineage-restricted stem and progenitor cells in vitro and/or in vivo are critical for the development of stem cell-based clinical therapeutics. Lineage-restricted stem and progenitor cells have many advantageous qualities, including being able to efficiently engraft and differentiate into desirable cell types in vivo after transplantation, and they are much less tumorigenic than pluripotent cells. Generation of lineage-restricted stem and progenitor cells can be achieved by directed differentiation from pluripotent stem cells or lineage conversion from easily obtained somatic cells. Small molecules can be very helpful in these processes since they offer several important benefits. For example, the risk of tumorigenesis is greatly reduced when small molecules are used to replace integrated transcription factors, which are widely used in cell fate conversion. Furthermore, small molecules are relatively easy to apply, optimize, and manufacture, and they can more readily be developed into conventional pharmaceuticals. Alternatively, small molecules can be used to expand or selectively control the differentiation of lineage-restricted stem and progenitor cells for desirable therapeutics purposes in vitro or in vivo. Here we summarize recent progress in the use of small molecules for the expansion and generation of desirable lineage-restricted stem and progenitor cells in vitro and for selectively controlling cell fate of lineage-restricted stem and progenitor cells in vivo, thereby facilitating stem cell-based clinical applications.

Scientific Abstract:
Generation and manipulation of lineage-restricted stem and progenitor cells in vitro and/or in vivo are critical for the development of stem cell-based clinical therapeutics. Lineage-restricted stem and progenitor cells have many advantageous qualities, including being able to efficiently engraft and differentiate into desirable cell types in vivo after transplantation, and they are much less tumorigenic than pluripotent cells. Generation of lineage-restricted stem and progenitor cells can be achieved by directed differentiation from pluripotent stem cells or lineage conversion from easily obtained somatic cells. Small molecules can be very helpful in these processes since they offer several important benefits. For example, the risk of tumorigenesis is greatly reduced when small molecules are used to replace integrated transcription factors, which are widely used in cell fate conversion. Furthermore, small molecules are relatively easy to apply, optimize, and manufacture, and they can more readily be developed into conventional pharmaceuticals. Alternatively, small molecules can be used to expand or selectively control the differentiation of lineage-restricted stem and progenitor cells for desirable therapeutics purposes in vitro or in vivo. Here we summarize recent progress in the use of small molecules for the expansion and generation of desirable lineage-restricted stem and progenitor cells in vitro and for selectively controlling cell fate of lineage-restricted stem and progenitor cells in vivo, thereby facilitating stem cell-based clinical applications.