Highly efficient sorting of adult stem cells by enhanced hydrodynamic filtration coupled with spiral microfluidics

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Human bone marrow-derived mesenchymal stem cells (hMSCs) consist of heterogeneous subpopulations with different self-renewal and multipotent capacities. Thus, sorting out a specific hMSC subpopulation with high self-renewal and multipotent capacities is a useful approach to enhance effectiveness of cell therapy. We separated hMSCs by using a double layered Dean flow-aided HDF chip without any critical cell damage. We previously reported the hydrodynamic filtration (HDF) microfluidic chip having straight multi-branch channels. In this study, to improve sorting efficiency and throughput, spiral geometry in upper layer as an additional sorter using inertial focusing effect was applied to the lower layered HDF chip. The hMSCs were sorted into three subpopulations: rapidly self-renewing (RS) (< 23 μm), spindle-shaped (SS) (23-35 μm), and flattened (FL) (> 35 μm) cells. Higher purity and recovery was achieved than those of our previous results. The results of adipogenic and osteogenic differentiations also demonstrated a successful fractionation of three subpopulations; RS and SS subpopulations showed higher self-renewal and multipotent capacities than those of FL subpopulation.