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Proteoglycans, and human mesenchymal and neural stem cells—can we control lineage fate?

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Human neural stem cells (hNSCs) and mesenchymal stem cells (hMSCs) are now routinely used in cell culture models; however, the processes and the mechanisms that regulate these cells are still largely unknown. Despite hMSC neural lineage potential, our current lack of understanding of lineage regulation limits their use in the development of human neurogenesis models as well as our understanding of how numerous neurological and brain disorders occur. How these processes are regulated will help to further unravel the structural complexity of the human brain, and the role of associated biological and other factors in neurogenesis. These also have important ramifications for the successful integration of newly formed neurons into existing/remaining neural circuits. The heparan sulfate (HS) and chondroitin sulfate (CS) proteoglycans (PGs) are widely distributed in the body and the nervous system, primarily in the extracellular matrix. Multiple studies have identified a role for these proteins during normal development of the nervous system as well as in the maintenance of stem cell pools in the adult. What is yet to be elucidated is how these PGs contribute to the control of neural lineage regulation, proliferation and differentiation? NSCs provide a promising model for understanding the process of neurogenesis. In addition, MSCs have neural lineage potential and may mediate stemness as well as lineage specification. The identification of the factors regulating these cellular processes will complement broader research disciplines that could be applied to all fields of research and may provide new strategies for their efficient implementation in therapeutic applications.

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