Biological Phenomena of Neural Stem Cell Differentiation

Ghosh, Sabrina

Parthasarathy, Arvind

Recognizing an insufficiency in therapeutic strategies for repair and regeneration in regard to neurodegenerative diseases, we focus on decreasing current controversial animal model testing for drug efficacy and pharmacology by offering an alternative method that effectively differentiates cells. Due to current low-yielding techniques, robustly differentiating neural stem cells (NSCs) and expanding their longevity is a pressing issue. To better understand the exact mechanisms of how surface substrates can induce more efficient cell differentiation, a triad of analyses were performed. Our goal was to study the underlying phenomena that affect cell differentiation and its interaction with surfaces, primarily graphene. The study reveals distinctive and perplexing morphological changes, quantitative progressions of cells, and marker expressions throughout the development of NSCs. The research maintains that a self-equilibrium is obtained by tension of actin filaments and compression of microtubules. The graphene's high density of cell bodies and cell-to-cell interactions indicates thickening of nervous tissue for tissue-based assays. Most significantly, these analyses prove that the basal process of radial glial cells elongate to retain attachment to microscopic pillars, which create targets for NSC neurites to sense. Thus, this proves that graphene provides a basis for the development of new tools for studying mechanosensing and testing pharmaceuticals. By solving previously unanswered questions of the NSC differentiation process, the research suggests that graphene's stiffness triggers stem cell response, and its sustained mechanical tension induces stretch growth in neurons, thereby providing a viable method to stimulate neurogenesis.

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