Exploring Hemispheric Lateralization: Implications for Parkinson's Disease and Cell Transplantation Therapies

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Background: Hemispheric lateralization refers to the distinct information-processing properties exhibited by the cerebral hemispheres of the human brain (1). There is a well-established specialization of function in the two hemispheres, with the left hemisphere primarily specialized for language function in right-handed individuals. In contrast, the right hemisphere is mainly specialized for visuospatial function in right-handed individuals and ambidextrous individuals with no hand preference (2). Evidence also suggests that paw preference in rats is similar to human handedness (3). Despite the evolutionary development of hemispheric specializations in humans, their role in cell transplantation for Parkinson's disease (PD) remains poorly studied. Previous studies have indicated that cell transplantation in the striatum of the dominant hemisphere, as opposed to the non-dominant hemisphere in 6-hydroxydopamine lesioned rats, resulted in improved motor behavior (4). However, the potential underlying factors for the improvement in motor behavior have not been explored. This experiment aims to investigate whether lateralization exists in the case of the substantia nigra pars compacta (SNpc) and striatum between the dominant and non-dominant hemisphere animal groups.

Methods: We hypothesize that animals within the dominant hemisphere will exhibit a significantly higher population of dopaminergic neurons, as well as variation in volume in SNpc and striatum compared to the non-dominant hemisphere animal group. (N=15) Sprague Dawley rats will be assigned to a paw preference test to determine the degree of handedness (right, left, or ambidextrous) as a measure of hemispheric dominance. Subsequently, a rodent behavioral battery test (RBBT) will be performed, followed by euthanasia, Cresyl violet (CV) staining and Tyrosine hydroxylase (TH)-immunohistochemistry. Stereological quantification of TH expression will be done on SNpc and striatum in each hemisphere using Stereo Investigator (MBF Bio.) software. The potential finding of variation in intrinsic factors between dominant hemisphere and non-dominant hemisphere animals is crucial for understanding successful cell transplantation in PD patients.

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