Metals in Brain Vs Neurodegenerative Disorders

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Disruption in homeostasis of metals present inside the brain are implicated in the etiologies of several neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease[1]. Hence, acquiring knowledge on spatial distribution and concentration of these metals within the brain paves a way to better understand the mechanisms of these diseases. The techniques that have been utilized for decades such as imaging followed by immunohistochemical staining of tissue, auto-metallographic techniques, mass spectroscopy either alter the concentration of metals from tissue fixation or lack spatial resolution[2, 3].

Here we use synchrotron x-ray fluorescence spectroscopy on unfixed tissue sections to measure concentrations of multiple metals of interest both at tissue and cellular level within the brains. Our results indicate that mercury (Hg), a highly toxic heavy metal is localized within the choroid plexus and lateral cerebral ventricular wall of our animal model (wildtype small Indian mongoose). We were further able to locate that astrocytes preferentially accumulate this metal, this metal colocalizes almost to a full extent with selenium, indicating a Se-based detoxification mechanism of Hg. We were also able to localize manganese (Mn) to purkinje cellular layer in the cerebellum of SLC39A14 (a manganese transporter gene) -knocked out model of mice thereby reporting that in addition to the previously reported periventricular zone, cells from cerebellum play a major role in the etiology of Parkinson's disease.

References:

[1] S. Pfaender, A.M. Grabrucker, Characterization of biometal profiles in neurological disorders, Metallomics 6(5) (2014) 960-77.

[2] S. Horai, Y. Nakashima, K. Nawada, I. Watanabe, T. Kunisue, S. Abe, F. Yamada, R. Sugihara, Trace element concentrations in the small Indian mongoose (Herpestes auropunctatus) from Hawaii, USA, Ecological Indicators 91 (2018) 92-104.

[3] G. Danscher, Applications of autometallography to heavy metal toxicology, Pharmacol Toxicol 68(6) (1991) 414-23.