X-ray eyes bring us closer to early diagnosis of Parkinson's disease

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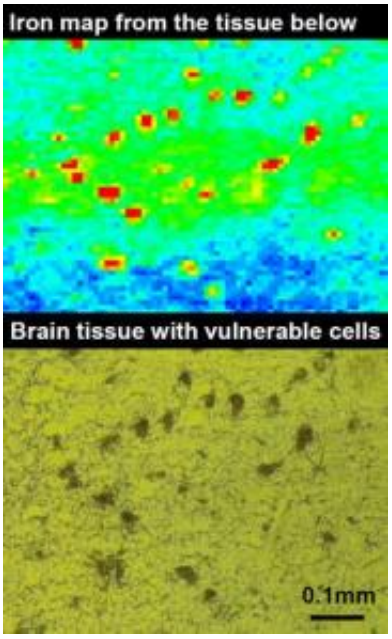

This is an iron map of brain tissue with vulnerable cells relating to Parkinson's disease. Credit: Copyright Diamond Light Source

It is estimated that 4 million people world-wide are suffering from Parkinson's, a complex disease that varies greatly among affected individuals. Understanding the brain chemistry that leads to the onset of Parkinson's is vital if we are to develop methods for early MRI diagnosis and new treatments for this devastating disease.

Speaking at the AAAS Meeting in Chicago, Dr Joanna Collingwood,

from Keele University, will present new results from studies carried out, in collaboration with Dr Mark Davidson from the University of Florida (UF), at Diamond - the UK's national synchrotron. Their results show that the distribution of metal ions in the brain tissue of sufferers is altered by the disease process. By studying the tissue as a whole, it has been possible to map metal distribution throughout the brain region containing the vulnerable motor neurones in Parkinson's disease in a region where they had earlier shown that iron levels nearly double in individual cells [Oakley 2007]. The primary support for this research is provided by the Engineering and Physical Sciences Research Council (EPSRC) in the UK.

Dr Collingwood comments, "Our studies at Diamond involve a technique called microfocus spectroscopy, in which powerful, tightly focussed beams of X-rays penetrate our tissue samples. We have been able to investigate human tissue with such precision that metal ions, particularly iron levels, in and around individual cells can be mapped. What makes the microfocus synchrotron approach so unique is that we can also use the focussed beam to obtain information about the form in which the iron is stored. Thanks to several years of work on optimizing the tissue preparation method at the Materials Research Collaborative Access Team at the Advanced Photon Source (APS) led by Dr. Davidson and Drs. Jon Dobson, of Keele and Chris Batich of UF, the technique is pioneering in that it does not change the distribution or form of the metals in the tissue being studied. We are grateful to the National Institutes of Health (NIH) in the USA for supporting this vital work. The impact of tissue preparation on the metal ions has been overlooked in many research projects in this area to date".

"To move this research on into the clinical arena, we need to determine how much the contrast change seen by clinicians in the MRI scan results is directly due to changes in iron distribution and form. Improving our understanding of the biochemical aspects of the disease should in the

long term contribute to improved therapeutic approaches and also provide potential openings for early MRI detection and diagnosis. Early diagnosis is key because we know that by the time a typical individual presents with the symptoms of the disease, chemical changes have already caused significant cell death of vulnerable motor neurones. We have been working closely with Dr. John Forder and Dr. Keith White at the Mcknight Brain Institute at UF to begin MRI studies of early diagnosis and translate the results from Diamond and the APS in Chicago into clinical relevance."

Due to the ageing of the world population, the importance of Parkinson's disease as a public health issue is expected increasing. The ultimate goal of this research is to find a method for early diagnosis so that medical treatment can begin as soon as chemical changes are detected and before the irreversible cell death takes place.

Treatment to remove or inactivate metals in the body is already available for people suffering from iron overload disorders, and is known as chelation therapy. As improvements in scanning techniques enable earlier detection of changes in the brain, it may be possible to diagnose Parkinson's disease much earlier and, with further advances in therapeutic research, find chelation-based therapeutic approaches for patients to intervene before they experience irreversible levels of cell loss. In the case of Parkinson's disease, a more targeted approach is necessary, as the overall systemic iron levels are not elevated. Rather, local regions affected by the disease are involved, making the knowledge obtained by the synchrotron techniques more critical to the design of appropriate treatments.

Publications:

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Source: Diamond Light Source