



Iron and Alzheimer's Disease: New Insights From New Imaging Techniques

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Background: Abnormal accumulations of iron have been known to be associated with Alzheimer's disease (AD) for over 50 years. In the intervening time, however, very little progress has been made in understanding the origin, nature and role of iron compounds in neurodegeneration. We have recently developed novel techniques which, when combined, allow us to not only locate and map the distribution of anomalous iron compounds in situ in AD tissue but also to identify and quantify the specific compounds present.

Objective(s): (i) To modify and develop physics-based methods for imaging, locating and characterizing anomalous iron compounds in Alzheimer's Disease. (ii) To use information obtained from these studies to inform the development of MRI-based early diagnosis techniques and to understand the possible role of iron and other metals in AD pathology

Methods: Synchrotron x-ray analysis, Superconducting Quantum Interference Device magnetometry and transmission electron microscopy/electron tomography were employed to map and characterize iron compounds in AD and control tissue samples.

Conclusions: Using these novel techniques, we have identified specific, anomalous iron compounds associated with Alzheimer's tissue in general and plaque cores in particular. High concentrations of magnetite (a mixed-valence iron oxide) appear to be dominant in the plaque core with levels also raised in bulk tissue samples from AD females. A second, ferrous iron oxide, wuestite, is also present in some anomalies. Both of these compounds may promote oxidative damage by providing a source of ferrous iron and via triplet state stabilization due to the magnetic fields they generate. In addition, electron microscopy analysis indicates a potential malfunction of ferritin within AD plaque cores.

The results of these studies will shed light on the potential role of iron in AD pathogenesis and help to inform the development of early detection techniques and new investigations of chelation therapies.

FIG. 1: Electron tomographic reconstruction of an AD plaque core.

