Increased level of magnetic iron oxides found in Alzheimer's disease

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A team of scientists, led by Professor Jon Dobson, of Keele University in Staffordshire, UK, have found, for the first time, raised levels of magnetic iron oxides in the part of the brain affected by Alzheimer's Disease (AD).

Their research has also shown that this association was particularly strong in females compared to males. The group speculates that this may be a result of gender differences in the way the body handles and stores iron.

Though the results are based on a small number of samples, they give an indication that iron accumulation associated with Alzheimer's appears to involve the formation of strongly magnetic iron compounds. As these compounds have a strong effect on MRI signal intensity, with further study, it may be possible to use this as a biomarker for the development of an MRI-based Alzheimer's diagnostic technique.

The research team also included Quentin Pankhurst, London Centre for Nanotechnology and Department of Physics & Astronomy, University College, London; Dimitri Hautot, Institute of Science and Technology in Medicine, Keele University, and Nadeem Khan, Department of Neuropathology, Institute of Psychiatry, King's College London.

The study looked at brain tissue from 11 Alzheimer’s Disease and 11 age-matched control subjects. It showed, for the first time, that the total concentration of biogenic magnetite is generally higher in the Alzheimer

brain (in some cases as much as 15 times greater than controls) and that there are gender-based differences, with Alzheimer's Disease with female subjects having significantly higher concentrations than all other groups.

Professor Dobson said: "Iron accumulation and dysregulation of iron transport and storage has been found to be associated with many other neurodegenerative conditions,
such as Parkinson's disease, Huntington's disease (HD), multiple sclerosis and Amyotrophic Lateral Sclerosis. In recent years, a hereditary neurodegenerative disease, neuroferritinopathy, has been linked to a mutation in the gene encoding for the ferritn light polypeptide. This direct link between neurodegeneration in the basal ganglia and ferritin, the body's primary iron storage protein, results in the accumulation of iron in the brain and symptoms similar to HD.

"There is still little known about the chemical form of iron associated with these diseases, its role in neurodegeneration (if any) and its origin. Investigations of brain iron based on histochemical staining techniques have generally ignored its chemical state."

This study shows a clear correlation in the concentration and the size of the biogenic magnetite in both the Alzheimer disease and control groups. It is also notable that the largest magnetite concentrations and smallest particles are all from Alzheimer disease subjects, and that the data from the control subjects follow the same trend. This implies that the genesis of the biogenic magnetite may be the same in all cases, but that in Alzheimer Disease it may be more indicative of an accelerated process.

Professor Dobson added: "We speculate that magnetite formation within the ferritin core may occur generally in the brain, perhaps associated with aging, and that the process may become abnormal and uncontrolled in the Alzheimer brain. At this stage, this should be considered a

working hypothesis and needs to be examined in larger studies. It appears, however, that elevated levels of magnetic iron oxides, which include reactive Fe2+, are present in AD tissue, a finding that lends weight to the suggestion that redox-active iron may play a role in neurodegenerative disease."

A paper on the study, Increased Levels of Magnetic Compunds in Alzheimer's Disease, is scheduled for publication in the January 2008 issue of the *Journal of Alzheimer's Disease* (Volume 13:1).

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