

SWI Metalheads: imaging brain iron: Diseases of iron deposition

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Abstract:

Iron is a normal component of brain tissue and it is involved in neuronal tissue function. However, there is increasing evidence showing that iron accumulation in the brain are associated with neurodegenerative disorders. A physiological phenomenon is increasing accumulation of brain iron (associated with ferritin) with the process of ageing. The earliest manifestations are a drop in signal intensity on T2-weighted sequences in the globus pallidus, red nucleus, pars reticulata of the substantia nigra and dentate nucleus that occur as early as in the second decade of life. After the second decade there is an increasing volume of the globus pallidus showing low signal intensity, and from the seventh decade onwards there is an increasing volume of the putamen that shows low signal intensity. Apart from these physiological increases in signal intensity, changes in signal intensity that are based on iron accumulation can be observed in pathological conditions too. Parkinson's disease (PD) is associated with increased iron accumulation in the substantia nigra, and is believed to give rise to cell damage through enhanced generation of reactive oxygen species and an increase in oxidative stress and protein aggregation. In Alzheimer's disease (AD) iron accumulates without the normal age-related association with ferritin, which increases the risk of oxidative stress. In AD, iron is also found in association with amyloid plaques, which contributes to the visibility of plaques on MRI in ex-vivo and preclinical in-vivo studies. Neurodegeneration with brain iron accumulation (NBIA), formerly known as Hallervorden-Spatz syndrome, is a group of genetic disorders characterized by brain iron deposition and associated with neuronal death. Known causes of NBIA include pantothenate kinase-associated neurodegeneration (PKAN), neuroferritinopathy, infantile neuroaxonal dystrophy (INAD), and aceruloplasminemia. Each of these different types of NBIA seem to have characteristic and distinct radiological features. Finally, hemorrhages can give rise to iron accumulation in the brain. The manifestations on MRI of the different stages of the evolution of hematomas are well known, more subtle manifestations, such as microbleeds and superficial siderosis, are less widely known and increasingly recognized using the new generation of susceptibility-weighted sequences.