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Celebrating 35 Years of the AJNR

May 1987 edition

Study of Movement Disorders and Brain Iron by MR

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Heavily T2-weighted high-field MR images provide a unique opportunity for the evaluation of the extrapyramidal motor system. The images are affected by the presence of small amounts of naturally occurring paramagnetic substances—principally iron—that delineate the neostriatum (caudate and putamen), globus pallidus, red nucleus, substantia nigra, and dentate nucleus, primarily by a decrease in signal secondary to the T2* effect. Movement disorders are associated with either increased or decreased signal or both in these structures, depending on the pathologic process. In the initial evaluation of 113 patients with a variety of movement disorders, good correlation of imaging abnormalities can be made with a simplified schema of the extrapyramidal pathways and a system of classification of abnormal movements, parkinsonism/tremor, dystonia, chorea, myoclonus, and hemiballismus. Parkinsonisms are characterized by abnormalities of the cortico-ponto-cerebello-dentato-rubro-thalamo-cortico-spinal tract or the nigrostriatal tract. Dystonias are characterized by abnormalities of the neostriatum predominantly affecting the putamen. Choreas are also characterized by abnormalities of the neostriatum but predominantly affecting the caudate nucleus. Hemiballismus is characterized by lesions affecting the subthalamic nucleus or associated pathway.

Iron

Interest in movement disorders is heightened by the recent ability to map the distribution of macromolecular complexes of Fe(III) in the brain with heavily T2-weighted images. This is accomplished through contrast created by the T2* effect, a local inhomogeneity in the magnetic field that dephases spin and results in loss of signal [1]. This effect is different from the paramagnetic effect of smaller soluble contrast agents, such as gadolinium, and corresponds roughly with the ferric iron

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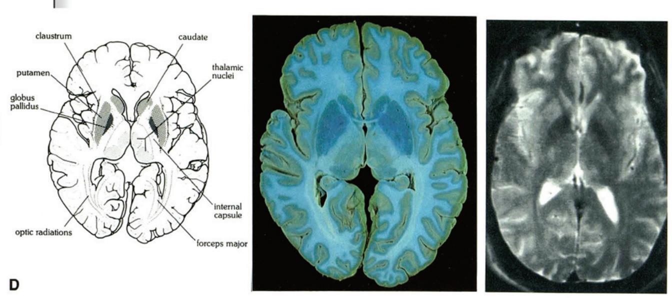

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Radiation Effects on Cerebral White Matter:

MR Evaluation

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**The purpose of this study was to evaluate the white-matter changes associ
cranial radiation by MR imaging. The MR scans of 95 patients receiving con
external beam radiation for a wide variety of central nervous system tum
reviewed. Moderately T2-weighted spin-echo images with a 2000-msec repet
and 56-msec-echo time were analyzed for white-matter abnormalities without k
of the patient's history. These were correlated with radiation dose, port, and tim
since completion of therapy, and then compared with an age-matched control
180 patients with nonirradiated, space-occupying, intracranial lesions. Radiatic
lesions were characterized as symmetric, high-signal foci in the periventricu
matter. Relative sparing of the posterior fossa, basal ganglia, and internal caps
noted. In patients older than 20 years, these changes paralleled those seen in
but were more prevalent ($p < .005$). In 25 patients with sequential MR sca
findings remained stable. In those patients with limited treatment fields, for
pituitary adenomas, no statistical differences were seen between radiation-tre
nontreated groups. Cerebral white-matter changes that mimic deep white-matt
tion are frequently seen in response to therapeutic radiation. There is a
incidence of radiation effects, becoming more marked in older patients. MR inte
must consider the neuropathologic consequences of therapeutic radiation, whic
demyelination, microvascular occlusion, and blood-brain barrier breakdown.**

The goal of therapeutic radiology is to provide a sufficient dose to trea
nervous system (CNS) tumors without affecting adjacent healthy tissue.
therapeutic regimens have been implemented, long-term effects of neurot
the surviving patients have been recognized [1–3]. A spectrum of CNS
has been noted on CT including atrophy, decreased attenuation of the deep
white matter, and rarely focal, enhancing radionecrosis [4–7]. The fir
neurotoxicity have been correlated with clinical findings in both patients ar
experiments [1]. More recently, similar findings of radiotherapy-related l
the brain have been described with MR [8–10]. Of interest, is the formatio
white-matter periventricular foci characterized by prolonged T1 and T2 r
times compared with normal white matter [10] in a pattern suggestive
demyelination or ischemia. Both can be identified readily by MR [11]. S
natural prevalence and severity of focal periventricular abnormalities (e.g., deep white-matter infarction) increase with age [11, 12], these abnormalities must be considered before ascribing changes to radiotherapy. For this reason, a retrospective review of a large patient population was undertaken; MR was used to further characterize the effects of radiation on cerebral white matter with respect to age, prevalence, time of onset, and both the temporal and spatial stability of these lesions.

Materials and Methods

MR imaging was performed using a Diasonics MT/S system operating at 0.35 T. Multiple-

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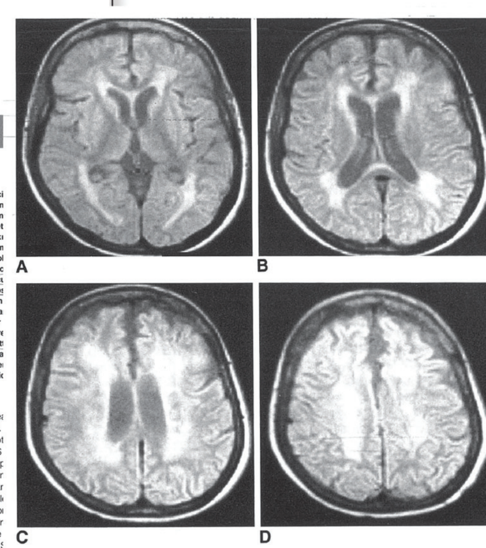

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