MAGNETIC RESONANCE IMAGING IN WHITE MATTER DISEASES OF THE BRAIN

ESSAY

SUBMITTED IN PARTIAL FULFILLMENT OF
MASTER DEGREE IN RADIODIAGNOSIS

BY

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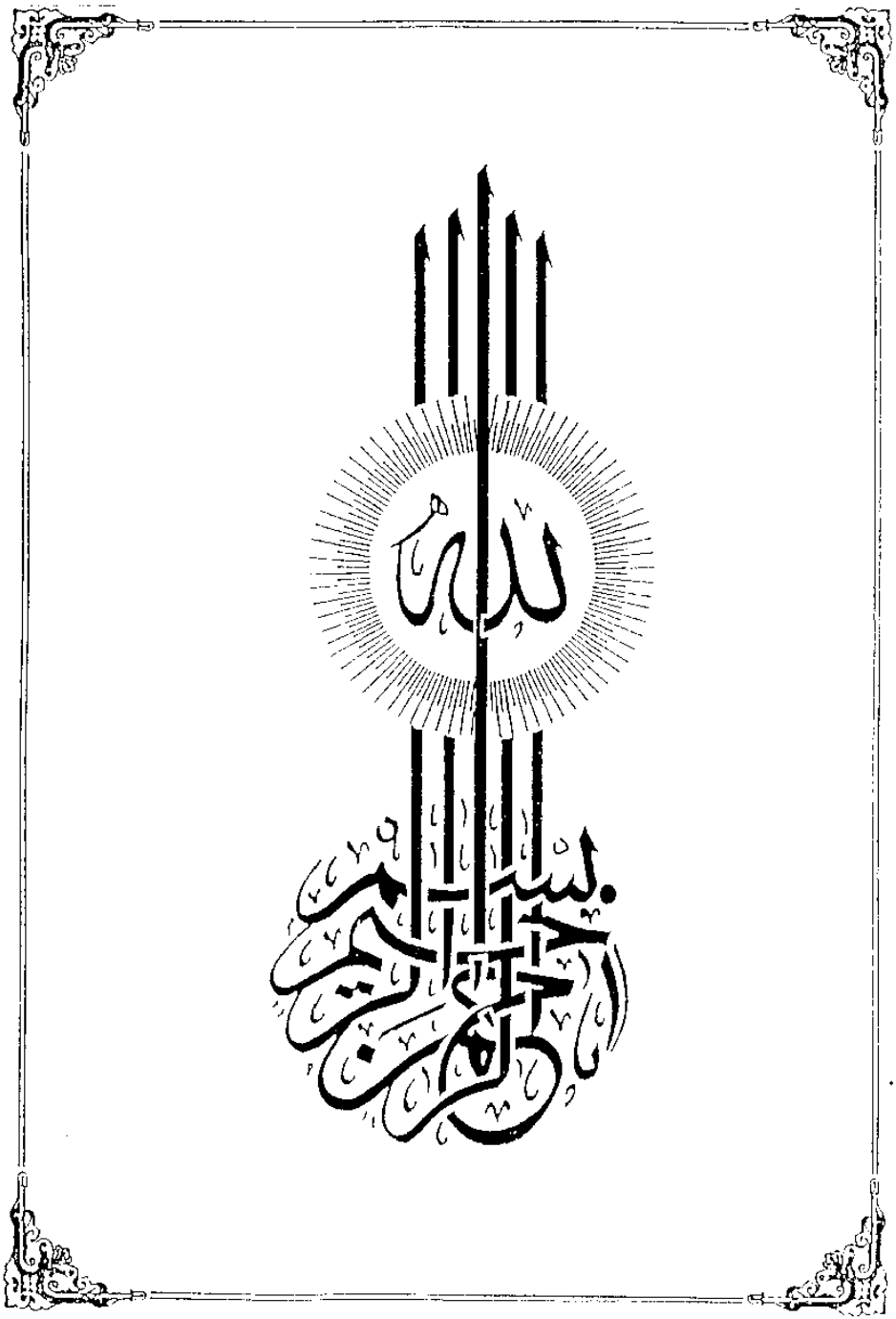

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INTRODUCTION AND AIM OF WORK

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INTRODUCTION AND AIM OF WORK

The cerebral (and cerebellar) white matter is affected by various disease processes, these include disorders of demyelination and dysmyelination.

Magnetic resonance imaging (MRI) is sensitive to the slight difference in tissue composition of normal gray and white matter and to subtle increase in water content associated with myelin disorders.

Several studies [(*Tobias et al., 1986*), (*Drayer et al., 1987*), (*Patel et al., 1987*)] proved the superior capability of MRI over computed tomography (CT) in detecting white matter diseases.

Hence; MRI is uniquely suited for examination of the white matter pathology.

The aim of this study is to highlight the MRI manifestations of white matter diseases of the brain.

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EMPRYOLOGY OF THE WHITE MATTER OF THE BRAIN

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EMBRYOLOGY

The Parts Derived From Cerebral Vesicles Are Listed As Follows:

A- RHOMBENCEPHALON (Hind Brain)

1- Myelencephalon

a- Medulla oblongata.

b- Caudal part of 4th ventricle.

2- Metencephalon

a- Pons.

b- Cerebellum.

c- Middle part of 4th ventricle.

3- Isthmus Rhombencephalon

a- Anterior medullary velum.

b- Superior cerebellar peduncles.

c- Cranial part of 4th ventricle.

B- Mesencephalon (Mid brain)

1- Cerebral peduncles.

2- Tegmentum.

3- Tectum.

4- Aqueduct.

C- Prosencephalon

1- Diencephalon

a- Thalamus (fore brain).

b- Metathalamus.

c- Caudal hypothalamus.

d- Caudal part of 3rd ventricle.

2- Telencephalon

a- Cranial hypothalamus.

b- Cranial part of 3rd ventricle.

c- Cerebral hemispheres.

d- Lateral ventricles.

e- Interventricular foramina.

(Warwick & William 1973).

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Each cerebral hemisphere is formed of outer gray matter (cerebral cortex), underlying white matter (centrum semiovale) and small internal masses of gray matter (basal ganglia). In other words the brain consists of gray matter (nerve cells and myelinated nerve fibers) and white matter (myelinated nerve fibers). Developement of the Human brain is incomplete at birth. Myelination of the nervous system proceeds rapidly in the perinatal period, occuring first in the peripheral nervous system, then the spinal cord and last in the brain *(Dobbing et al., 1973).*

The process of myelination is one in which the water content of the white matter of the brain decreases and its lipid content increases. Myelination of the brain begins during the fifth fetal month with the myelination of the cranial nerves and continues throughout life (*Yakovlev and Lecours, 1976*). (Fig 1--->6).

At birth myelination is present in the medulla, dorsal midbrain, cerebellar peduncles, posterior limb of the internal capsule and ventro- lateral thalamus, maturation proceeds from:

1- central to peripheral.
2- Inferior to superior, and
3- Posterior to anterior. (*Barkovich and Jackson , 1989*).

The cerebellum is myelinated at 3 months of age with an adult appearance on T2 weighted images. The pre and post central gyri are myelinated at 1 month and maturation of motor tracts is complete by 3 months. The pons matures from 3--->6 months, with maturation proceeding rostrally along the cortico-spinal tracts, cerebral peduncles, through the posterior limb of internal capsule and central portion of the centrum semiovale (*Barkovich and Jackson, 1989*).

The optic nerves, tracts, and optic radiations (into the occipital white matter) are myelinated by 3 months and the anterior limb of the internal capsule by 2--->3 months. The subcortical white matter matures starting at 3 months in the occipital region and proceeds rostrally to the frontal lobes. Myelination in the corpus callosum can be a helpful landmark when estimating myelin development.

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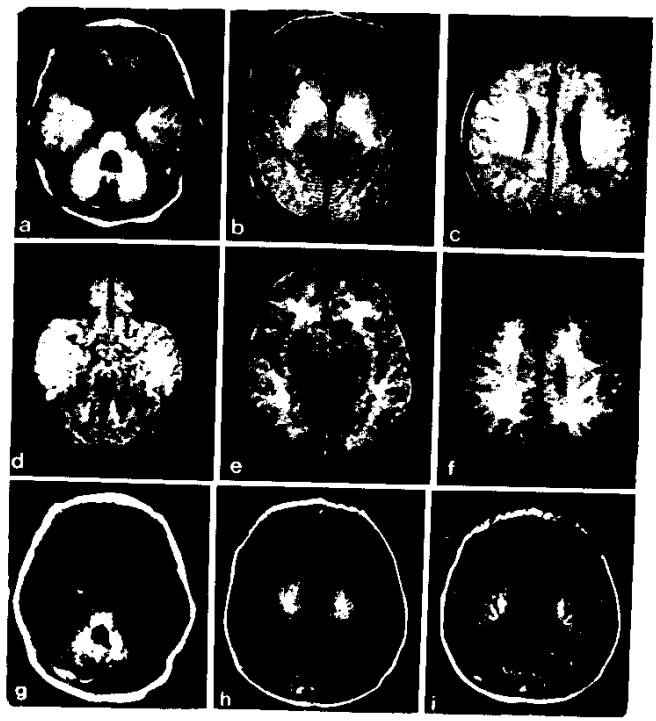

Fig (1). Myelination stage I. Shown are 3000/30 (a-c) and 3000/120 (d-f) SE images and 2800/600 IR images (g-i). On the short TE SE Images and the IR images the myelinated structures stand out bright against a background of unmyelinated white matter with low signal intensity and gray matter with intermediate signal intensity. On the long TE SE images the myelinated structure are isointense with gray matter: the unmyelinated white matter is hyperintense. Note that the CSF has an intermediate signal intensity as a result of the comparitively long T1 and T2 of brain tissue.

Quoted from SOILA, (1989).

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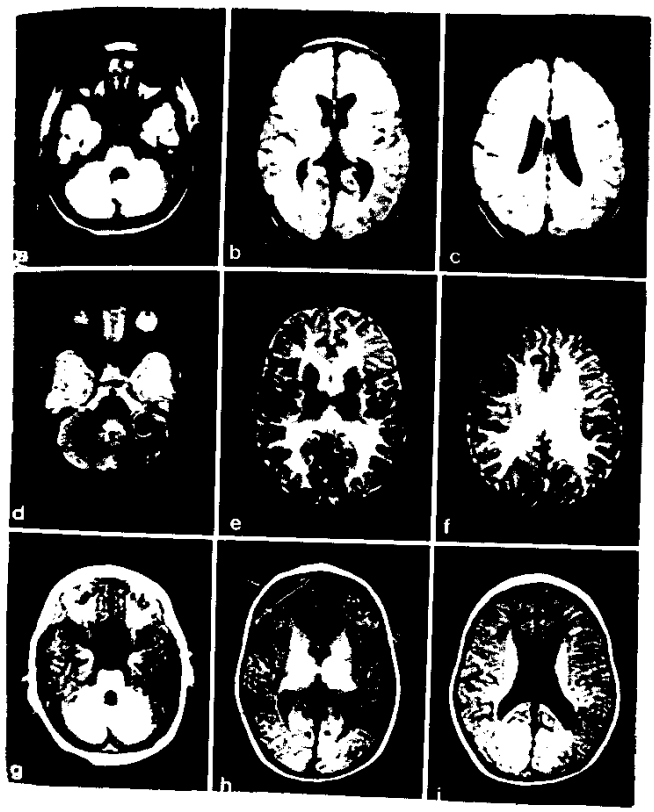

Fig (2). Myelination stage II. Shown are 3000/30 (a-c) and 3000/120 (d-f) SE images and 2400/600 IR images (g-i). On the short TE SE images the myelinated brain stem and cerebellar white matter tend to hypointensity. For the rest the whole picture has an intermediate signal intensity and is featureless. On the long TE SE images the myelinated central structures are hypointense, the peripheral myelinated structures are isointense with gray matter, the unmyelinated white matter is hyperintense. The IR images clearly show some progress of myelination compared to stage I.

Quoted from SOILA, (1989).

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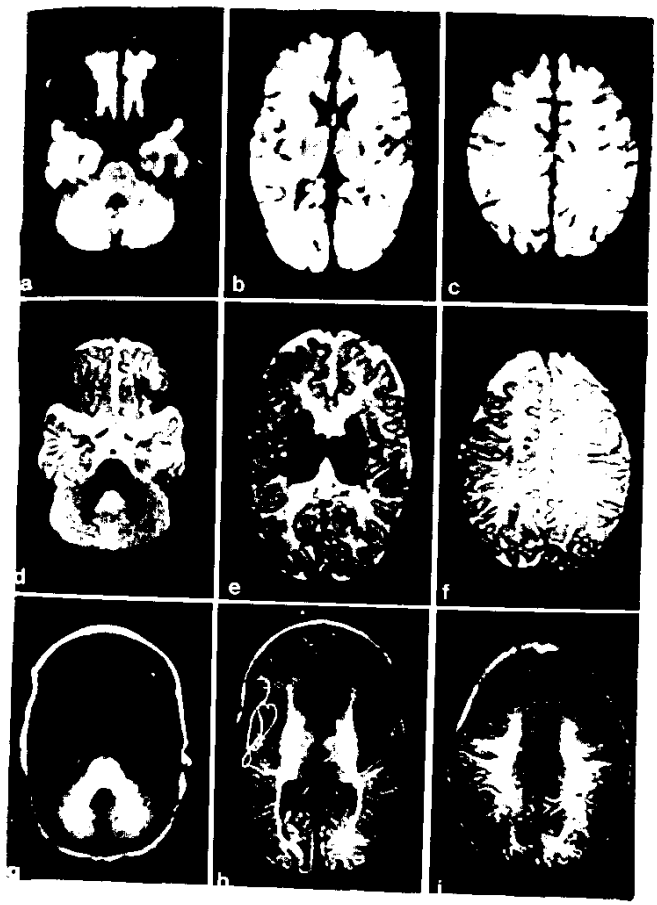

Fig (3). Myelination stage III. Shown are 3000/30 SE images (a-c), 3000/120 SE images (d-f) and 2400/600 IR images (g-i). On the short TE SE images the myelinated central structures are definitely hypointense. The unmyelinated peripheral white matter is hyperintense, the partially myelinated peripheral white matter (corona radiata) is isointense with gray matter. On the long TE SE images the contrast differences are more pronounced but essentially the same. The IR images are easier to interpretate and show the extensions of myelination in the occipital and parietal white matter.

Quoted from SOILA, (1989).

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