MR Diffusion Weighted Imaging in non Infarct Brain Lesions

Essay

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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Ibrahim Badawy

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List of Abbreviations

ADC	:	Apparent diffusion coefficient
CE	:	Contrast enhanced
CNS	:	Central nervous system
CPA	:	Cerebellopontine angle
CPM	:	Central pontine myelinolysis
CT	:	Computed tomography
DAI	:	Diffuse axonal injury
DWI	:	Diffusion weighted imaging
eADC	:	Exponential ADC
EPM	:	Extra-pontine myelinolysis
FLAIR	:	Fluid attenuation inversion recovery
FOV	:	Field of view
FSE	:	Fast spin echo
GBM	:	Glioblastoma multiform
GD-DTPA	:	Gadolinium diethylenetriaminepentacetate
HIE	:	Hypoxic ischemic encephalopathy
i.e	:	Id est (latin) = that is
JPA	:	Juvenile pilocytic astrocytoma
MRI	:	Magnetic resonance imaging
MS	:	Multiple sclerosis
n	:	number

PCNSL	:	Primary CNS lymphoma
PRES	:	Posterior reversible encephalopathy syndrome
TB	:	tuberculosis
TE	:	Time for echo
TR	:	Time of repetition
WE	:	Wernicke's encephalopathy

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Introduction

Diffusion weighted imaging (DWI) is a relatively new method in which the images are formed by the contrast produced by the random microscopic motion of water molecules in different tissues. Although DWI has been tried for different organ systems, it has been found its primary use in the central nervous system [(1)].

Diffusion-weighted (DW) magnetic resonance (MR) imaging provides potentially unique information on the viability of brain tissue. It provides image contrast that is dependent on the molecular motion of water, which may be substantially altered by disease. The method was introduced into clinical practice in the middle 1990s, but because of its demanding MR engineering requirements—primarily high-performance magnetic field gradients—it has only recently undergone widespread dissemination [(2)].

Diffusion-weighted imaging (DWI) has greatly enhanced the ability of MRI to diagnose cerebral infarct early and accurately. This technique exploits the phenomenon of diffusion, which is related to Brownian motion at the molecular level. DWI takes advantage of the fact that intracellular water molecules are much more limited in their movement than extracellular ones, because they quickly bump into the cell membrane that contains them. The more restricted the movement of water, the brighter it will be on DWI sequences [3].

DWI consists of a DW image, also called the diffusion trace, and an apparent diffusion coefficent (ADC) map. DW image is a T2-weighted echoplanar background image attenuated by the rate of apparent diffusion. DW image, together with qualitative and quantitative assessment of the ADC map has been widely used in the diagnosis of acute cerebral infarction, owing to the reliable distinction of cytotoxic and vasogenic edema[2].

Diffusion-weighted MR imaging not only has the advantage of enabling differentiation of acute stroke from chronic stroke [4]. DWI has recently been described and suggested in the differential diagnosis of various non-infarct lesions of the brain which are hyperintense in the diffusion trace image, such as infectious, neoplastic and demyelinating diseases, encephalopathies (including hypoxic- ischemic, hypertensive, eclamptic, toxic, metabolic and mitochondrial encephalopathies) leukodystrophies, vasculitis and vasculopathies, hemorrhage and trauma. The pathophysiologic changes for such hyperintense DWI include high viscosity, high cellularity, vacuolization and compartmentalization of water [2].

Aim of the work

To study the role of Diffusion weighted MR imaging in the evaluation of non-infarct lesions of the brain.

Cross Sectional Magnetic Resonance Anatomy of the Brain

Computed tomography (CT) and magnetic resonance imaging (MRI) have revolutionized the study of the brain by allowing doctors and researchers to look at the brain noninvasively. These diagnostic imaging techniques have allowed for the first time the noninvasive evaluation of brain structure, allowing doctors to infer causes of abnormal function due to different diseases [5].

The exquisite detail provided by brain magnetic resonance imaging scans can make interpretation simultaneously straightforward and complicated, particularly to the novice. For this reason, it is essential to become familiar with normal structures before describing the pathologic condition [6].

The overwhelming advantage of MR imaging is its ability to provide images with increased signal to noise ratios. Tissue characteristics with respect to different imaging sequences provide valuable clues when interpreting an MR image of the brain. Therefore, it is important to understand the accentuated tissue features on each scan [7].