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Modified magnetic Resonance Imaging (MRI) Brain protocol for diagnosing multiple Sclerosis (MS)

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ABSTRACT

The Objective of this study is to modify MRI protocol to meet the requirements of multiple Sclerosis (MS) diagnosis.

Materials and Methods: *This study was done in Alamal National Hospital using closed magnet, sign high definition with magnetic field strength (1.5 t) (Philips), during the period from June 2014 to December 2014, included 55 patients males and females who came to the MRI department for MRI brain examination .*

Results: *From this study the best protocol to visualize all the M.S in the new and old (follow up) brain cases by using modified protocols, Axial, Sagittal and Flair with 3 mm slice thickness instead of 5 mm and slice gab 0.00 zero instead of 1 mm were used to cover any MS that might be missed in routine protocol and discover a new MS. Out of 20 patients scanned by MRI, 11 (55%) were males and 9 (45%) were females. The patients' ages ranged from 24 to 60 years.*

Conclusion: *The best MRI protocol for detection and diagnoses of M.S is the modified protocol suggested by this study. The result showed that 55 % of the affected patients were males and 45%. were females.*

KEYWORDS : MRI protocols, multiple Sclerosis

Introduction:

MS is a chronic, progressive, degenerative disorder of the central nervous system (CNS) characterized by disseminated demyelization of nerve fibers of the brain and spinal cord, MS usually affects young to middle- aged adults, with onset between 15 and 50 years of age the women affected more than men it's unknown etiological cause it may be related to infectious, immunologic, and genetic factors possible precipitating factors include (physical injury, emotional stress, pregnancy, poor state of health. Pathophysiology of mylelin sheath affected by segmented lamination that wraps axons of many nerve cells increases velocity of nerve impulse conduction in the axons, composed of myelin, a substance with high lipid content (Kalb & P. D.R.C 2008). Characterized by chronic inflammation, demyelination, and gliosis (scarring) in the CNS, initially triggered by a virus in genetically susceptible individuals subsequent antigen-antibody reaction leads to demyelination of axons .Disease process consists of loss of myelin, disappearance of oligodendrocytes, and proliferation of astrocytes changes result in plaque formation with plaques scattered throughout the CNS, initially the myelin sheaths of the neurons in the brain and

spinal cord are attacked, but the nerve fiber is not affected, patient may complain of noticeable impairment of function, myelin can regenerate, and symptoms disappear, resulting in a remission (Kalb & P. D.R.C 2008).The characteristic abnormalities of MS in the brain consist of multiple white matter lesions with a high signal intensity (SI) on fluid attenuation inversion recovery (FLAIR), proton density (PD)-weighted image(WI), and T2-WI and low signal intensity (SI) on T1-WI. Lesions are found predominantly in a periventricular distribution, Centrum semiovale, and the callososeptal interface. Additional sites of involvement include other parts of the cerebral white matter such as the sub cortical a penetrating medullary vein. Atypical lesions and mass-like lesions occur with sufficient frequency to cause diagnostic errors. MS lesions may enhance after contrast administration on T1-WI, depending on the age and activity of the lesion. New and active lesions commonly show contrast enhancement, due to BBB breakdown. New lesions tend to show solid enhancement, whereas reactivated lesions enhance in a ring-like fashion (Fazekas F et al 1999). After 2 months, the integrity of the BBB is restored, and the majority of lesions no longer show contrast enhancement. As with unenhanced lesions, the contrast-enhancing lesions are smaller than the corresponding lesions on the T2-W scan. The discrepancy between the size of the lesion on T1-WI and T2-WI reflects the different components of the local process: edema, inflammation, and demyelization. The poor correlation between the MRI findings and the clinical events is demonstrated by the frequent finding of enhancing lesions in clinically stable patients. White matter, optic nerves, corpus callosum, internal capsule, cerebellar peduncles, brainstem, and spinal cord. Demyelinating lesions appear smaller on T1-WI than on T2-WI. Occasionally, they show a hyper intense border on T1-WI (Fazekas F et al 1999). Lesions in MS can be small, large, or confluent the typical configuration is that of an ovoid lesion extending perpendicularly from the ventricular surface (Dawson's finger).This probably reflects the perivascular inflammation along found in the corpus callosum. Typically, these lesions occur along the inner callosal-ventricular margin, creating an irregular ventricular surface of the corpus callosum. This aspect can be differentiated from callosal atrophy due to the lobar white-matter lesions. The existence of callosal lesions improves both the sensitivity and the specificity of MRI for the diagnosis of MS. The absence of callosal lesions renders the diagnosis of MS less likely, but does not exclude it. A frequent initial presentation of MS is optic neuritis, although there is controversy regarding the likelihood of definitive MS developing in patients who have had an optic neuritis (Gray O, McDonnell GV and Forbes RB 2004). Brainstem lesions are common, and a lesion in the medial longitudinal bundle affects approximately one-third of MS patients. In patients with clinically possible MS and a normal MRI study of the brain, a spinal MRI study should be performed. MS is an inflammatory demyelinating disease of the CNS. It is the most common demyelinating disease after vascular- and age-related demyelination. MS is characterized by multiple "plaques" of demyelination in the white matter of the brain and spinal cord. The primary lesions are found in the perivascular spaces along penetrating veins. Though the etiology of MS is not fully understood, the destruction of myelin is most likely caused by an autoimmune process. Initial symptoms can sometimes be triggered by trauma or a viral infection, but a convincing link to the disease has not been made. (Gray O , McDonnell GV and Forbes RB 2004). The clinical course of MS is highly variable. The age of symptom onset in MS is usually between 18 and 40 years; onset is uncommon in childhood and after the age of 50 years. Initial symptoms may include numbness, dysesthesia, double vision, or problems with balance and coordination. Loss of motor function is also a frequent initial presentation. Less commonly, spinal-cord-related symptoms constitute the initial presentation of MS. There is a female: male ratio of 3:2. The most common clinical presentation is "relapsing- remitting" MS (70% of cases) (Rae-Grant et al 1999). Patients experience symptomatic episodes (known as "attack"), which can last from 24 h to several weeks, followed by complete or partial disappearance of symptoms (remission). The interval between relapses may be weeks to years (and even decades). As white-matter lesions increase over time, and neurologic disabilities increase, the disease frequently becomes "secondary progressive." Accumulating neurological deficits eventually lead to permanent disability. The evolution from relapsing-remitting to secondary-progressive MS occurs in approximately half of patients within 10 years after onset. Alternatively, in 10–20% of cases, MS can follow a "primary progressive" course; in this type of disease, there is a continuous, gradual evolution from the beginning, rather than relapses (Rae-Grant et al 1999).Research problems: Prevalence of MS patients whom were referred to the MRI department to examine brain, among The Sudanese population, in routine MRI brain protocols a hidden small MS does not seen due to a thicker slice (5 mm) and slice gab (1mm) , in some cases enhanced T1w with using contrast is the necessary to view inactive MS and to aid the deferential diagnosis between the MS and small vascular disease.

The common brain protocols, Axial T1, T2 and Flair. Sagital T1.Coronal :T2.

Slice gap: 1mm.Slice thickness: 5mm.

Materials and Methods:

Patients (Study sample): This was an experimental study which included samples of 20 patients 11 of them were males and 9 were females all of them underwent brain MRI study for suspected of multiple sclerosis, they were referred from modern medical centers in Khartoum .different genders and age groups. whom will be referred to the radiology department in modern medical centers in Khartoum with a suspected case of multiple sclerosis, undergone MRI examination, to standardize protocol to diagnose MS, child's and patient with brain tumors were excluded from the study, all patients will informed to obtain their consent before the exam and their information's will be used in this study, the data will be collected and interpreted by radiologist reports.

Machine used: The Machine used in this study was MRI scanner PHILIPS and GE (1.5 tesla), Philips machine in Alamal National Hospital, and GE machine in Antalea Diagnostic Center. Neurovascular head coil, ear plug, and immobilization bad were used.

Methods: MRI Technique used:
Field Strength: 1.5 T.

Slices : < 3 mm and no gap of plane resolution of < 1 mm for brain,

Sequences: 1st: Sagittal FLAIR. 2nd: Axial T2 .3rd: Axial FLAIR.4th: Gadolinium enhanced T1 (in follow-up).

The data were collected from the results of MRI scan findings and the results were supported by radiologist who determined wether the case is SI ,hyper, hypo or iso compared to normal brain area by observation and by measuring SI of affected area. Data were collected from findings which appeared in different MRI cuts and the data were represented in tables and graphs. The data's will include the general patients data (Age, genders and weight) and will be accompanied by the related to Symptoms and clinical information such as clinical signs (A numb or weak feeling in the face, trouble speaking, blurred or poor vision, loss of balance, headache, The risk factors and patients history (hypertension, D.M , heart disease).All data wered entered and analysed using the Microsoft Excel and statistical analysis soft ware statistical package for social sciences (SPSS) version 22 statistical analysis included description statistic of frequency tables, graphs, cross tabulation and tests were applied to compare the variables, the difference was considered significant when p-value is less or equal (0.05)**.**

Results: The results are shown on the following tables, figures and diagrams.

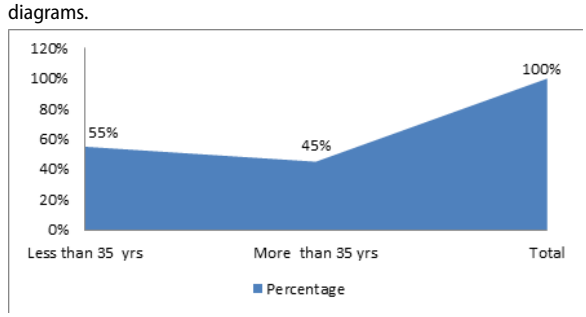

Figure (1) represents the frequency of multiple sclerosis patients according to the Age.

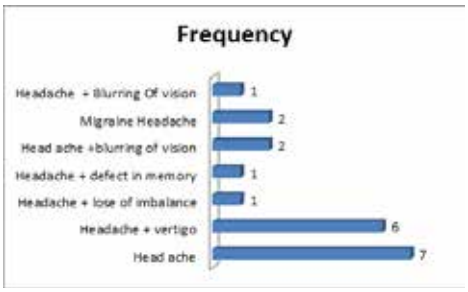

Figure (2) represents the frequency of clinical diagnosis in patients with multiple sclerosis.

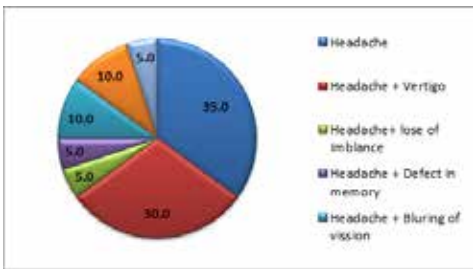

Figure (3): represents the percentage % of clinical diagnosis in patients with multiple sclerosis.

Table (1) illustrates the mean of finding MS in protocol 1 and protocol 2.

Measurement	Number	Mean of finding	P. vlaue
Protocol 1	20	15.8	0.000
Protocol 2	20	30.5	

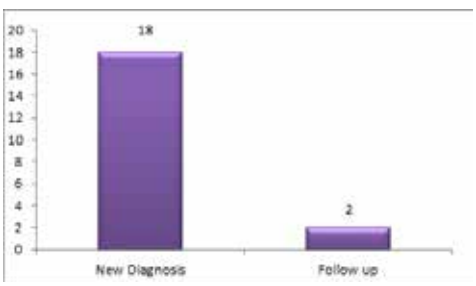

Figure (4): Shows new diagnosis and follow up patients with multiple sclerosis.

Discussion:

The preliminary investigations obtained from this study revealed that the MS patient's participated in this study, patients with ages more than 35 years were more affected than patient's with age less than 35 years .This remarks are reported by (Herna´n MA. et al 2001), who postulated that the risk of MS rises significantly with age after 35. In this study symptoms more frequently found were headache and headache + vertigo which in agreement with (McDonald et al., 2001). One of the most interesting observations obtained from this study were to cover all M.S in the brain and detected a new M.S by using modified MRI protocol, in this study represented by (protocol 2). Protocol 2 routine MRI brain and the most important sequence is FLAIR axial and sagital with 3 mm slice thickness and slice gap 0.0 mm to cover any M.S in the brain .The common brain MRI protocol applied in radiological center in this study was represented by (protocol 1). Protocol 1 in radiological center used axial T1,T2, FLAIR sagitalT1 and coronalT2 with slice thickness 5 mm and gap 1 mm were used. This protocol is good in survey brain but it cannot cover all M.S in the brain. (D. K. Li, et al 2004). From this result, the analysis showed that average of finding MS in protocol 1 was 15.8 and protocol 2 was 30.5. The P Value was 0.00, which means that the difference is significant between the two protocools. The result indicates that, protocol 2 is more accurate than protocol 1 for the detection all M.S in the brain.

Conclusions:

This study concludes that advances in neuroimaging have improved ability to diagnose and monitor MS and have provided insight into the pathophysiology of the disease. Conventional MRI of the central nervous system plays a prominent role in establishing the diagnosis of MS and in differentiating MS-mimics and demyelinating disease subtypes. Moreover, it allows an earlier and accurate diagnosis of the disease, as it can support or even replace some clinical criteria. Accurate diagnosis is essential to allow earlier therapeutic intervention that appears to be beneficial on delaying the accumulation of irreversible neurologic damage and consequent disability. Through this study, it is found that the best MRI protocol for detection and diagnosis of M.S is the modified protocol (protocol 2).

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