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RESEARCH ARTICLE

The Role of MRI in the Early Detection of Multiple Sclerosis.

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Manuscript Info

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Abstract

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Background: Multiple sclerosis (MS) is the most common inflammatory demyelinating disease of the CNS and the most frequent cause of nontraumatic neurological disability in young and middle-aged adults (1). Women are twice as likely to be affected as men, and onset typically occurs between the ages of 20 and 40 years (2). The diagnosis Depend on a detailed history; careful neurological examination; and supportive paraclinical investigations. According to the new McDonald criteria, the diagnosis of MS requires objective evidence of lesions disseminated in space and time.MRI findings may contribute to the determination of dissemination in time or space (4).

Aim of the study: the aim is to evaluate the role of MRI and find the most common findings in the early stages of the disease,which could provide the knowledge to help finding a higher quality care or even a cure to the disease.

Methodology: This retrospective descriptive study was conducted at security forces hospital, Riyadh city, kingdom of Saudi Arabia. Data was collected by chart and radiological images review of all patients from any age or gender who were 1st diagnosed with multiple sclerosis by MRI. From 01-01-2013 till 01-01-2016 to evaluate the MRI role and to find what are the most common MRI findings of multiple sclerosis in early stages of the disease.

Results: We have found that the MRI is the first choice of imaging in detecting Multiple Sclerosis. From our 50 patients 15(30%/) were diagnosed by active demyelinating MS and 35 patients (70%) were diagnosed by chronic demyelinating MS. The most used sequence in all the cases was T2 weighted, FLAIR was performed in 49 of the cases (98%), T1 after IV contrast was used in 7 cases (14%). The common findings in the chronic demyelinating MS were high signal intensity in T2 weighted and in Axial FLAIR, in active demyelinating MS was characterized by enhancement after IV contrast and restricted diffusion.

Conclusion: Most common technique for detecting MS in the early stages is Multiplanar Multisequential technique, we have found that the most common findings in Chronic multiple sclerosis are high signal intensity on T2 weighted images and flair and the active multiple sclerosis is represented by high enhancement after administration of IV contrast and in some cases, restricted diffusion is considered a sign of activity. MRI is in fact the most sensitive modality to detect MS at early stages.

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Introduction:-
Multiple sclerosis (MS) is the most common inflammatory demyelinating disease of the CNS and the most frequent cause of nontraumatic neurological disability in young and middle-aged adults (1). Women are twice as likely to be affected as men, and onset typically occurs between the ages of 20 and 40 years (2). The diagnosis Depend on a detailed history; careful neurological examination; and supportive paraclinical investigations. According to the new McDonald criteria, the diagnosis of MS requires objective evidence of lesions disseminated
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in space and time.MRI findings may contribute to the determination of dissemination in time or space (4).

General objectives:
To evaluate the role of MRI in the early detection of Multiple Sclerosis (MS).

Specific objectives:
fined the best sequence for detecting MS in the early stages of the disease.
fined the most common radiological findings in the early stages of MS.

Hypothesis:
Is there a best sequence for detecting MS in both active and chronic stages?

Problem of study:
Due to lack of full access of the patients recorded some information weren't able to reaches.
The short period due to the graduation semester didn't allow us to collect more data.

Importance of the study:
the disease is spreading among people. An early detection can help the patient to accept adapt and live with MS, because Managing MS is a process that begins with the very first symptom continuing throughout the disease.

Ethical consideration:
A singed consent was takin from princessesNora university and from security forces hospital,Riyadh, Kingdomof Saudi Arabia. the data was managedconfidential.

Literature review:-
Detention:-
Multiple sclerosis (MS) is consider one of the most common autoimmune diseases of the central nervous system (brain and spinal cord). (3)
MS is an inflammatory demyelinating condition; it is caused by damage to the myelin. Myelin allows the nerve to transmit its impulses rapidly. The loss of myelin (demyelination) is accompanied by a disruption in the ability of the nerves to conduct electrical impulses to and from the brain. This produces the various symptoms of MS. It is the speed and efficiency with which these impulses are conducted that permits smooth, rapid and coordinated movements to be performed with little conscious effort. (1)
In MS, the sites where myelin is lost (plaques or lesions) appear as hardened (scar) areas: in multiple sclerosis, these scars appear at different times and in different areas of the brain and spinal cord. (4)

Incidence and prevalence:-
MS is found in all parts of the world, its prevalence varies greatly, being highest in North America and Europe, and lowest in sub-Saharan Africa and East Asia. The number may be much higher as it is likely that many people with MS remain undiagnosed in certain parts of the world. There are about 2.3 million people in the world with MS. (1)
It is almost unheard of in certain populations such as the Inuits, New Zealand Maoris and Australian Aborigines. (1)

Risk factors associated with MS-
The Risk factors affecting MS includes, Age, MS can occur at any age, but most commonly it affects people between the ages of 15 and 60. Sex, Women are about twice as likely as men are to develop MS, suggesting a role of

hormones in the disease's process. Family history, if one of the patient parents or siblings has had MS, they are at higher risk of developing the disease. (3)

There is a slightly higher risk of developing MS if the patient suffers from some types of disease for example, if the patient has thyroid disease, type 1 diabetes or inflammatory bowel disease. smokers usually have a higher risk of devolving MS than nonsmokers especially if they experienced an initial event of symptoms that may signal MS. (7)

Signs and symptoms:-

Multiple sclerosis signs and symptoms depends in the location of the damaged nerve fiber, they may differ greatly from one person to another and over the course of the diseases.

The Symptoms of MS mayinclude; mental changes for example, decreased concentration, attention deficit and memory loss. Visual disturbances like, eye pain, loss of vision in one eye, blurred vision and color distortions. bladder and bowel dysfunction and some muscles disability like muscle spasms, fatigue, numbness and prickling pain. (3)

Stages of MS:-

There are different forms of MS, depending on how it progresses. The disease can be: Primary progressive, this means that the symptoms are experienced by the patient regularly from the beginning. (4)

Secondary progressive, this means that the symptoms are not constantly experienced by the patient at first after that the attacks become more steady. This happens to many people who start out with relapsing-remitting disease. (7)

Relapsing-remitting, this means the symptoms of MS may come and go. Calling it an attack when the symptoms flare up. These attacks can last for days to weeks and usually refine slowly. Between attacks, people often feel ordinary While others may suffer from post attack effects. Relapsing-remitting is the most common type of MS. (6)

Progressive relapsing, this means that the worsening of the symptoms is steadily present from the beginning, and the attacks are also considered inconstantly occurring. (3)

Diagnosis of MS:-

There are no specific tests for MS a diagnosis often relies on ruling out other conditions that might produce similar signs and symptoms, known as a differential diagnosis. (6)

Blood tests help to check for specific biomarkers associated with MS a, Lumbar puncture (spinal tap), in which a small sample of fluid is removed from the spinal canal for laboratory analysis. This sample can show abnormalities in antibodies that are associated with MS. (7)

MRI, is the diagnostic role that currently offers the most sensitive imaging of CNS. It can detect many more MS lesions than CT, and it can detect plaques in regions that are rarely abnormal on CT such as the brainstem, cerebellum, and spinal cord. Most lesions seen on MRI correlate with pathologic lesions. Patients with clinically definite MS have typical white matter lesions on MRI in nearly all cases. (2)

MRI evidence plays a supportive role in what is ultimately a clinical diagnosis of MS, in the appropriate clinical situation, and always at the exclusion of alternative diagnoses. (5)

A standardized MRI protocol for brain and spinal cord is crucial to differentiate between different diagnosis or between centers, this protocol called Multiplanar multi sequential technique. (6)

Gadolinium provides useful information about new lesion activity and is helpful in ruling out alternative diagnoses such as neoplasm, vascular malformations, and leptomeningeal disease. A single gadolinium-enhanced MRI can potentially provide evidence for dissemination in space and time. (7)

Spinal cord imaging is equally valuable to rule out spinal stenosis or tumor, and for detecting asymptomatic lesions when brain imaging is nondiagnostic in patients suspected of having MS. (3)

Evoked potential tests, which record the electrical signals produced by the nervous system in response to the stimuli. An evoked potential test may use visual stimuli or electrical stimuli, in which the patient watches a moving visual pattern, or short electrical impulses are applied to nerves in the legs or arms. Electrodes measure how rapid the information travels down the nerve pathways. (6)

The reason behind choosing this specific topic is how largely the disease is spreading among people. An early detection can help the patient to accept adapt and live with MS, because Managing MS is a process that begins with

the very first symptom continuing throughout the disease. Our study was held to evaluate the role of MRI in the early detection of MS, Since MRI is a powerful tool in detecting the disease it might provide an early detection even if the symptoms are not experienced by the patient yet and provide the knowledge to help finding a higher quality care or even a cure to the disease.

Material and Methods:-

This retrospective descriptive study was conducted at security forces hospital, Riyadh city, kingdom of Saudi Arabia, to evaluate the MRI role and to find what are the most common MRI findings of multiple sclerosis in early stages of the disease. Data was collected by medical chartswhich include demographic data (age and gender) and the radiological images review of all the sequences preformed for each patient who were diagnosed with multiple sclerosis by MRI from 1-1-2013 till 1-10-2016 and the data sample was 50 case.

Inclusion criteria:-
All cases that have been first diagnosed with Multiple Sclerosis By MRI.

Exclusion criteria:-
Relapsing stages of Multiple Sclerosis.

Date presentation:-
Data was presented by chart and tables

Data management:-
The data was analyzed by SPSS program.

Results:-

This retrospective descriptive study was conducted at security forces hospital, includes 50 patients diagnosed with multiple sclerosis who have undergone MRI imaging of the brain and spine performed from 01/01/2013 to 01/10/2016, including 7 (14%) males and 43(86%) females. (table1).

Regarding age, the age range was between 17 to 58 years old and a median of 31 years old and a mean of 32 and a stander deviation of 10,34. our data were grouped into 3 categories, less than 26 years, includes 18 patients (36%), 26 to 40years, includes 23 patients (46%), more than 40 years includes 9 patients (18%) (table1).

Multiple sclerosis affects women more commonly than men; we have found that 14% of the cases were males and the other 86% were females. The ratio of women to men having the disease is 43:7.

As showing in table 1 we have found two forms of the disease in the early stages: active demyelinating MS includes 15 patients (30%/), while chronic demyelinating MS includes 35 patients (70%).

Table 1. Demographic data of 50 patients with Multiple Sclerosis

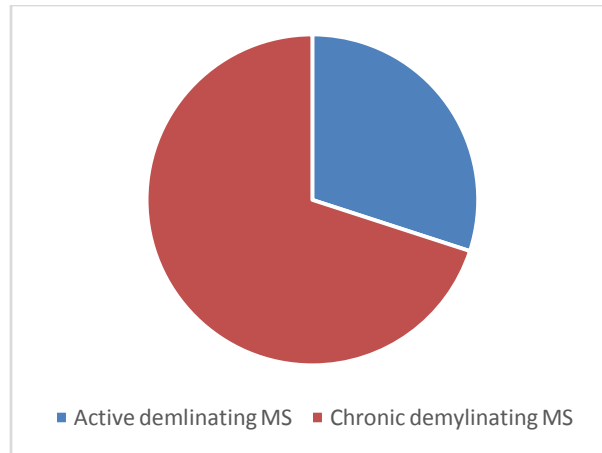|	Frequency	%
Age (years)		
Less than 26	18	36 %
26-40	23	46 %
40+	9	18 %
Gender		
Female	43	86 %
Male	7	14 %
Stages of MS		
Active demyelinating MS	15	30%
Chronic demyelinating MS	35	70%

Figure 1. Stages of Multiple Sclerosis

We have found that some of the cases haven't applied the standardized technique for Multiple Sclerosis which is called multiplanar multi-sequential technique (table 3).

T2 weighted was the most common sequence which used in 49 of the cases (98%), Axial T1, Axial Flair and Axial Gradient Echo are used in 49 of the cases (98%), T1 after IV contrast was used in 7 cases (14%), T1 FAT SAT after IV contrast was used in 43 cases (86%). Diffusion was applied in 49 of the cases (98%) (table 2).

Table 2. the sequences preformed in 50 patients of Multiple Sclerosis

Sequence	Frequency	%
Sagittal, Axial, Coronal T2	49	98%
Axial T1	49	98 %
Axial Flair	49	98 %
Axial Gradient Echo	49	98 %
T1 After IV Contrast	7	14%
T1 Fat Sat After IV Contrast	43	86 %
Diffusion	49	98 %

Table 3. The dominant standardized technique in the study population

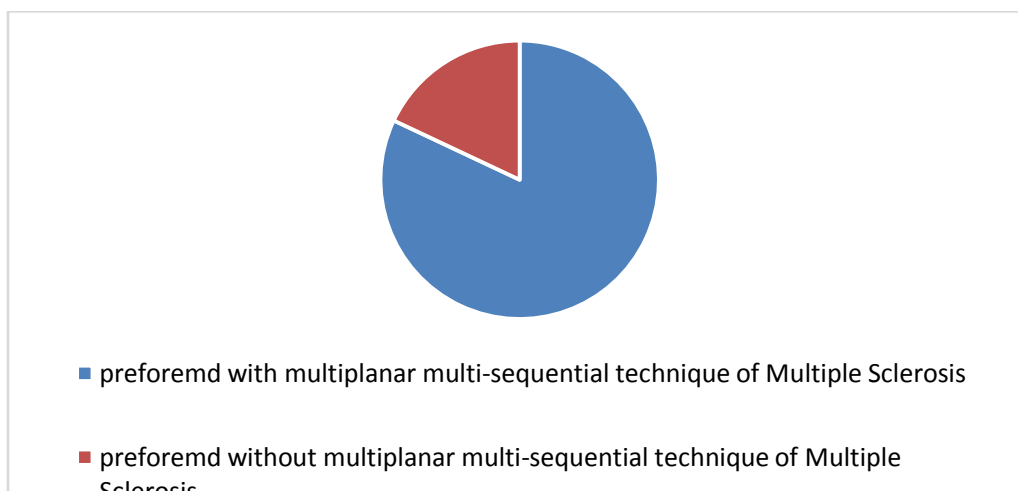|	Frequency	%
Preformed with multiplanar multi-sequential technique	41	82%
Preformed withoutmultiplanar multi-sequential technique	9	18%

Figure2. multiplanar multi-sequential technique of Multiple Sclerosis.

Since comparable MRI abnormalities may be found in a variety of other diseases we have found that certain abnormalities are always present in the early stages of multiple sclerosis.
We have found that Chronic multiple sclerosis shows high signal intensity on T2 weighted images and flair. The active multiple sclerosis is represented by high enhancement after administration of IV contrast and in some cases, restricted diffusion is considered a sign of activity.

All the cases (100%) shows high signal intensity on weighted T2. 45(90%) of the cases shows high signal intensity on flair. 2 (4%) of the cases shows small focal hemangioma. white matter changes appeared in 10 (19%) of the cases. 21 (42%) of the cases showed enhancement after IV contrast. Restricted diffusion appeared in 16 (32%) of the cases (table4).

Table 4. The MRI findings in the study population

Common MRI findings	Frequency	%
High signal intensity on t2 weighted	50	100%
High signal intensity on flair	45	90%
have a Few small focal hemangiomas	2	4%
White matter changes	10	19%
Enhancement after IV contrast	21	42%
Restricted diffusion	16	32%

Discussion:-

The diagnosis of MS has traditionally relied upon accumulation of information, clinical and paraclinical, that leads to a positive diagnosis and can help to eliminate alternative diagnoses. The typical MRI findings in multiple sclerosis reflect the histopathology of the disease.
The result of Paty DW, Oger JJ, Kastrukoff LF, *et al. (*1988) research supports the hypothesis that consider MS a genetic disease which means that having a relative carrying the disease could increase the risk of developing it, however a valid evidence is not confirmed yet. We have noticed that some families have the disease more than others, but we couldn't determine if it is an actual factor or not, due to the lack of access to the patient's clinical history. (10)

We found in our 50 patients that Two stages of the disease are shown in the early diagnosis: active demyelinating MS and chronic demyelinating MS. We found a subtype of chronic MS the relapsing-remitting MS (RRMS) which is characterized by unpredictable relapses followed by a relative quiet period with no new signs of disease activity,we also found a subtype of active MS called Primary-progressive MS (PPMS) which is characterized by clearly defined relapses of increased disease activity and worsening symptoms, this matches the result of Barkhof F, Filippi M, Miller DH, *et al. (*1997) research. (11)
We have found that Some of our patients have a benign course of the disease. Which means that they only have mild symptoms and slow disease progression. Some studies show that some of these people experience some progression after 10 to 20 years.

We have found that Magnetic Resonance Imaging (MRI) offers the most sensitive imaging of the CNS, it can detect multiple sclerosis lesions better than CT and it can detect plaques in regions that are rarely abnormal on CT such as the brainstem, cerebellum, and the spinal cord. Therefore, we found that the first line of diagnosis in hospitals for MS is MRI.

As stated in Dalton CM, Brex, PA, Miszkiel KA, *et al.* (2002). research that There is a standardized MRI protocol for brain and spinal cord that is crucial for comparing between studies or to differentiate diseases that have similar symptoms as multiple sclerosis, such as seizure or stroke. our result matches this study, the protocol is known as the multiplanar multi-sequential technique which is a combination of all the sagittal, coronal and axial planes in addition to a before and after IV contrast images. (17)

We found that T2 weighted images always show high signal intensity in both active and chronic types which indicate the presence of a lesion, but it lacks the ability to distinguish between active and chronic lesions. The administration of gadolinium helps to determine the activity of the lesion and to roll out some other diseases.

A research by M Korostil and A Feinstein studded the relationship between alternative diagnoses and MS , it stated that there is a relationship between anxiety disorder and the onset of Multiple Sclerosis and patients with anxiety disorder should be scanned on a regular basis to look for Multiple Sclerosis. due to the social factors in Saudi Arabia there is less awareness about mental disorders, people here tend to ignore their mental health leading in a delay of the early diagnosis of MS in some cases. (3)

The findings of the study byMiller DH, Weinshenker BG, Filippi M, et al. (2008) assessed that a comparable MRI abnormalities may be found in a variety of other diseases, as shown in our result there are certain abnormalities that are always present in the early stages of multiple sclerosis. 20 present of the cases showed changes in the white matter, some showed multiple periventricular/peri-callosal white matter changes and the other showed white matter edema. (22)

Conclusion:-
The most common technique for detecting MS in the early stages was Multiplanar Multisequantal technique, and the most common MRI findings in Chronic multiple sclerosis were high signal intensity on T2 weighted images and flair and the active multiple sclerosis is represented by high enhancement after administration of IV contrast and in some cases, restricted diffusion is considered a sign of activity. So, we conclude that the MRI is in fact the most sensitive modality to detect MS at early stages.

Recommendation:-
Further studies should be done on the relation between the genetic factor and the onset of the disease. The benefit from these studies could asses an earlier detection of the disease if a relative carries it.

Acknowledgement:-

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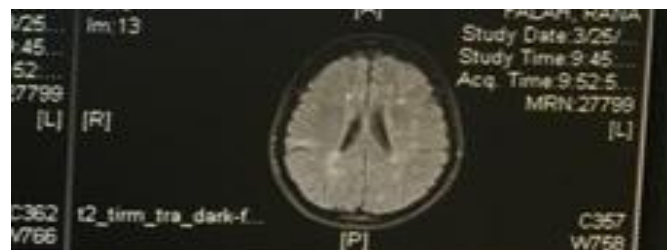
Appendices:-
Images of different stages of Multiple Sclerosis

Case #1: 47-year-old female with chronic Multiple Sclerosis

Case #2:36 years old female with active Multiple Sclerosis

Case#3: 52 years old female with chronic Multiple Sclerosis