The Libyan International Medical University

Faculty of Basic Medical Science

Relation between multiple sclerosis (MS) and brain atrophy

Student name : selema el Fergana

Student number : 2202

Supervised by : Rema Alfakhry

Supervised by : Fatima Ewrith

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Abstract

Multiple sclerosis (MS) is an immune-mediated disease of the central nervous system characterized by focal or diffuse inflammation, demyelination, axonal loss and neurodegeneration. Brain atrophy can be seen in the earliest stages of MS .
Atrophy of gray matter is associated with the degree of disability in patient with MS . In these study resulted show the use of the EDSS (expanded disability status scale), together with MRI volumetric measures, ensures a reliable correlation between radiological appearance and clinical state and provides the best characteristic of functional impairments in MS .

The aim of study was to evaluate the relationship between brain atrophy quantification in multiple sclerosis (MS) patients and the progression of disability measured by neurological tests.

Introduction

MS Autoimmune demyelinating disease of nerve cell in brain , spinal cord characterized by various neurological disorders. More effect female then male , characterized by focal areas of white matter demyelination and gray inflammation (1).

Brain atrophy, or brain shrinkage, is an important manifestation of multiple sclerosis It's one of the most destructive result of the disease (1) . Brain atrophy can be seen in the earliest stages of MS and may lead to irreversible impairments. Whereas, MRI lesions are highly distributed in white matter (WM) and gray matter, the brain tissue that appears in MRI is also affected by pathological studies (1). Causes of MS (unknown) and pathogenesis are cell mediated (type TV) hyper sensitivity reaction (2). T cell , B cell , Macrophages .

T cell : break through blood brain barrier lead to activation by myelin proteins(myelin basic protein) , Th17 cell produced cytokines lead to the attract other leukocytes , Th1 cell produce interferon gamma lead to activation of macrophage ,so T cell produce cytokines (IL1 ,IL6 ,TNF-alpha) that lead to oligodendrocytes damaged , blood brain barrier express more receptors for other leukocytes , blood vessels dilate easier passage for other leukocytes (2).

B cell: produce antibodies that bind to myelin protein and mark them(2) .

Macrophage : recognize marked oligodendrocytes , engulf them attacks occurs in 2 stage ,early stage : regulator T cell reduce inflammation lead to oligodendrocytes heal , renew myelin (remyelination).

Later stage : repetitive extensive damage lead to death of oligodendrocytes , loss of myelin ,damage ,loss axons . 4 types of MS: 1- Relapsing remitting multiple sclerosis (RRMS) bouts of autoimmune attacks ,months to year ,improvement after attack .2- primary progressive multiple sclerosis (PPMS)one constant attack lead to progression of disabilities over lifetime. 3- secondary progressive multiple sclerosis (SPMS) start as (RRMS) ,over time become constant lead to progression of disabilities .4- progressive relapsing multiple sclerosis (PRMS) one constant attack , lead to faster progression of disabilities. Risk factor of MS 1- genetic factor : individuals who are biologically female twice as susceptible , polymorphisms of certain alleles of major histocompatibility complex (e.g HLA DR2 : identifying, binding of foreign molecules) .2- Environmental : infection (e.g Epstein Barr Virus infection) , vitamin D deficiency , usually affects young adults.

Signs and symptoms of MS : Charcot's neurologic triad : dysarthria , nystagmus , intention tremor . Lhermittes sign : bending neck forward lead to electric shock. Depression activates ,anxiety .

Plaque location :

(brainstem) conscious movements (e.g difficulty talking and eating),unconscious movements (e.g difficulty swallowing)(2) .

(Eye nerve) : optic neuritis (e.g loss of vision) ,eye movement nerve (e.g double vision).

(motor pathway) muscle weakness ,spasms, tremors , ataxia ,paralysis .

(sensory pathways) paresthesias (tingling , itching , burning) .

(autonomic nerves system) constipation ,urinary incontinence ,sexual dysfunction.

Diagnosis of multiple sclerosis : is based on clinical evaluation (2) .

1. Electrophysiology :clinical neurologic symptoms with relapsing remitting course , visual excite potential : measure response to visual stimuli

2.Magnetic resonance imaging : (T1hypotensive -T2hypertensive lesion) orgadolinium enhanced ,nonenhanced lesion simultaneously , Dawson's fingers : plaques radiating outwards from corpus callosum in sagittal images.

3. CSF examination : High levels of antibodies (2) .

Treatment of multiple sclerosis :

(RRMS) corticosteroids , cyclophosphamids , intravenous immunoglobulin . Other IV plasmapheresis : removing antibodies ,Immunosuppressant .

Progressive multiple sclerosis : manage symptoms (e.g urinary incontinence) , physical therapy ,cognitive rehabilitation therapy ,vitamin D (2) .

Atrophy is the gradual degeneration or shrinkage of muscle or nerve tissue. In multiple sclerosis (MS) two types of atrophy are common: muscle atrophy (due to disuse of specific muscles) and brain or cerebral atrophy (due to demyelination and destruction of nerve cells)

Focal tissue loss in WM plaques is undoubtedly a major contributor to brain atrophy. However, correlation between demyelination and atrophy of the whole brain remains controversial (1) .

Inflammation can make a significant contribution to tissue loss in the early stages of the disease. Magnetic resonance imaging ,measure of brain atrophy dependent on the amount of tissue fluid that increase with active inflammation and angoedma in wm plaques and decrease during anti-inflammation drug .for this reason ,it is important to treat MS early on .to reduced brain volume loose (1) .

Materials and Methods

From one article used seventeen patients diagnosed with MS according to the Study population by McDonald (mean age 52 years, range 34-70 years). Patients were volunteer from the Department of Neurology at Wroclaw Medical University between 2014 and 2016. Demographic and clinical characteristics of multiple sclerosis (MS) patients and healthy controls (CG) . Control groupTwenty-four healthy volunteer (11males, 13 females), age range between 32 and 68 years (mean age48 years), with no history of neurological or psychiatric disorder .The inclusion criterion was normal MR imaging in table conventional brain .

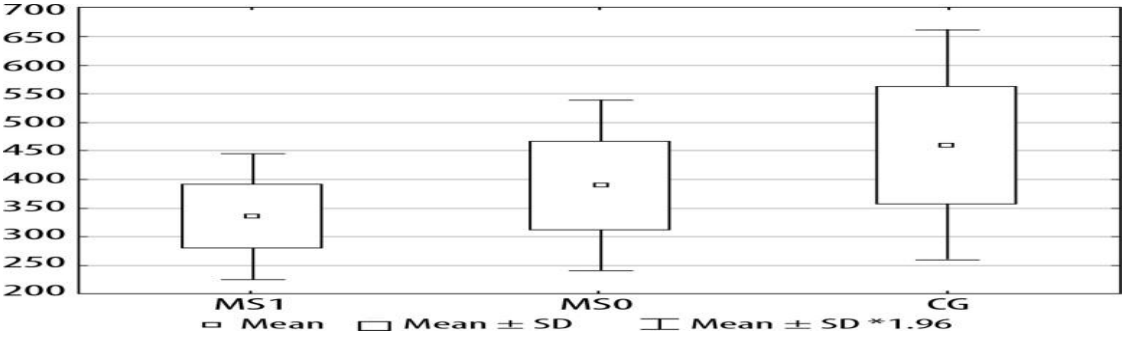
Factor	Ms	CG
Sex, M/F	12/5	13/11
Age years		
Mean	52	48
Range	70-34	68-32
MS estimated duration (years)	5-1	NA

Used MR imaging protocols Magnetic resonance imaging (MRI)was performed in 17 individuals with multiple sclerosis (MS) and in 24 control . MRI examination was performed on a 1.5 Tesla scanner using a 16-channel head coil. Data were transferred to a GE Advantage Workstation and post-processed using fully-automated software Free surfer image analysis . On the basis of the volumetric Bravo sequence, brain segmentation was performed .

Bravo is one of the basic acquisition protocols for Automated Brain Segmentation, use for measurement of brain volume because they provide excellent T1w contrast between grey and white matter and are good for showing anatomical details .and use Neurological assessment . All patients had a full neurological examination at the time the MRI scans were performed and after a two-year follow-up. The disability assessment was performed using the EDSS (expanded disability status scale) to evaluate functional impairments of MS. EDSS is the most widely-used measure for assessing the degree of neurological impairment in MS.

Results

MRA and brain volume change It was fond that total brain volume is stable indictor for determining the level of atrophy in patient with MS compared with healthy volunteers of age and gender , patient with MS during the observation period showed a significant decrease in the volume of the brain parenchyma in various regions of the gray matter . So the white matter do not show significant volume loss in patient with MS compared with health controls



1 - Comparison of the MS1 (patients with deterioration) and MS0 groups (patients without deterioration) Significantly higher volume loss was found in MS patients with progression compared to those with stable disease in several areas MS0 .

2 - Comparison of the MS0 (patients without deterioration) with the healthy control group, MS patients without progression showed significantly higher volume loss

3- Comparison of the MS1 (patients with deterioration) and CG groups. Significantly higher volume loss in MS patients with progression compared with healthy controls was observed within 14 grey matter areas.

Neurological assessment

Mean EDSS score at baseline was 3.029 (range 1.0-6.0).At the end of the follow-up period we found significant deterioration from baseline data for disability (mean EDSS 3.34, range 1.0-7.0). Overall, seven patients (41.1%) were judged as cognitively worsened (MS1 group – patients with deterioration) at the end of the follow-up, and 10 patient (58.9%)remained stable (MS0 group – patients without deterioration).

Discussion

Multiple sclerosis is a chronic autoimmune disease that causes neurological problems and results in progressive disability.
Multiple sclerosis-related brain atrophy is a consequence of both underline pathology (neuroinflammation) and neuroaxonal loss(3). Brain volume loss in MS patients occurs at a faster rate than in the healthy population: 0.5-1.0%vs. 0.1-0.3% per year(4) . Atrophy may be found early in the disease course even before clinical symptoms and lead to long-term neurological disability (5).Magnetic resonance imaging (MRI) is an important tool not only in the process of diagnosis but also in the monitoring of disease activity and predicting treatment Efficacy(6,7) .
The primary objective of this study was to evaluate the correlation between MR-based quantitative brain volume changes and clinical deterioration in the course of MS(8) .
There are several freely available tools for automated brain volumetric that are commonly used in MS patients(9). in these study they chose one of the most use software Free Surfer (10) . These automated techniques express the results as a percentage of the change in brain volume .Until now, EDSS has been a widely-accepted measure of clinical disability in MS patients and can provide useful information about the clinical state of the patients

Conclusions

(MS) is an immune-mediated disease of the central nervous system characterized by focal or diffuse inflammation, demyelination, axonal loss and neurodegeneration.
Brain atrophy can be seen in the earliest stages of MS.
Atrophy of gray matter is associated with the degree of disability in patient with MS .
In these study resulted show the use of the EDSS score, together with MRI volumetric measures, ensures a reliable correlation between radiological appearance and clinical state and provides the best characteristic of functional impairments in MS.

Future works for (MS) :

There must be awareness of the disease and early diagnosis and treatment better than late due to complications.

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