

Brain and spinal cord magnetic resonance imaging in Thai multiple sclerosis patients

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Abstract

Objective: To evaluate magnetic resonance imaging (MRI) of multiple sclerosis (MS) patients in Thailand. **Method:** A retrospective review on the initial brain and spinal cord MRI in MS patients was done but primary progressive MS and the AQP4 antibody positive patients were excluded. The characteristics of brain and spinal cord MRI were analyzed. **Results:** For the initial brain MRI studies, fifty percents satisfied McDonald MRI criteria for dissemination in space. For the initial spinal cord MRI, most lesions involved thoracic level and the mean length of spinal cord lesion is 1.29 vertebral body segments (range 0-3).

Conclusion: For Brain MRIs in Thai MS patients, there was 50% in sensitivity by the 2005 McDonald's Criteria for dissemination in space, which is similar to the previous Asian reports. For spinal MRI, the median length of lesions was less than previous Asian reports. This could be due to the fact that AQP4 antibody positive patients, in whom the clinical and imaging features are hard to differentiate from MS patients, were excluded. In other word, the neuromyelitis optica (NMO) spectrum disorders had been more effectively excluded in this study than those in the past. This supports the importance of NMO IgG/AQP4 antibody testing in differentiating MS from NMO spectrum disorders, especially in Asian patients.

INTRODUCTION

Multiple sclerosis (MS) is considered an uncommon disease in Asian and has been reported to show several different features from the western countries, which were lower prevalence, rare positive family history, higher prevalence in female, frequent occurrence of acute transverse myelitis, higher frequency of paroxysmal tonic spasm, less frequent involvement of cerebellum, higher prevalence of opticospinal form, lower incidence of positive oligoclonal bands in cerebrospinal fluid, and longer spinal cord lesions on magnetic resonance imaging (MRI).¹⁻⁷

In 2001, the International Panel on the diagnosis of MS⁸ proposed a guideline for the diagnosis of MS, which was revised in 2005.⁹ In both criteria, MRI is a very important tool to determine dissemination in space (DIS) and time (DIT) for the diagnosis of MS. Studies on MRI findings in MS in Asian as well as Thai populations revealed low sensitivity of McDonald MRI criteria for dissemination in space.¹⁰⁻¹¹

According to the revised diagnostic criteria of neuromyelitis optica (NMO)¹², the NMO antibody testing is very important. In Asia, the NMO IgG antibody detection was not available in the past. For that reason, some NMO spectrum disorder patients were diagnosed to have MS. That is very important because, although MS and NMO are both neuroinflammatory diseases, the first line treatment is different. For NMO, immunosuppressive drug is the first but for MS, the first line drug is Interferon beta. Therefore, we undertook this study to better delineate the MRI characteristics of Thai MS patients from whom we have excluded NMO spectrum disorder patients.

This study was conducted to evaluate magnetic resonance imaging (MRI) in multiple sclerosis (MS) patients in Siriraj Hospital MS clinic which is the large referral center of Thailand and excluded the NMO spectrum disorder by using NMO IgG antibody test.

METHODS

This was a retrospective study on the initial brain and/or spinal cord MRI in patients visiting MS clinic at Siriraj Hospital, Mahidol University, Bangkok, Thailand. MS patients with complete clinical data and the initial MRI was performed in Siriraj Hospital between September 2004 to September 2009 were included. Diagnosis of MS was based on the Revised Mc Donald criteria (2005). MS patients with primary progression (PP MS) or those for AQP4 antibody positive were excluded. MRI was performed with 1.5T or 3T machines. For brain MRI, the protocol included: sagittal T1wi, FLAIR; axial T1wi, PDwi and/or FLAIR, T2wi; coronal T2wi; and Gd-T1wi in three orthogonal planes. For spinal MRI, the protocol included: sagittal T1wi, PDwi and/or T2wi; axial T1wi/T2wi; and Gd-T1wi in sagittal and axial planes. The thickness of brain MRI was 3-7 mm (gap 0-0.7mm) and spinal MRI was 3-4 mm (gap 0 mm). Date, site of last relapse, number of lesions in T2wi, gadolinium enhancement,

brain or spinal cord atrophy, cord swelling, and McDonald MRI criteria for dissemination in space were evaluated in all patients. The Siriraj Institutional Review Board approved the study (697/2551).

RESULTS

In 293 MS clinic patients, there were 99 MS patients; only 40 patients had done the initial brain or spinal cord MRI or both of them during September 2004 to September 2009 in our hospital. There were 8 male and 32 female patients, with mean age of 38 years (range 16-68 years). Patients were classified into relapsing remitting (30 patients), progressive relapsing (4 patients), and secondary progressive (6 patients) MS. Those with initial brain MRI, initial spinal cord MRI and both studies in the same person were 36, 24 and 20 patients respectively. Examples of the brain and spinal cord MRI are shown in Figure 1 and 2.

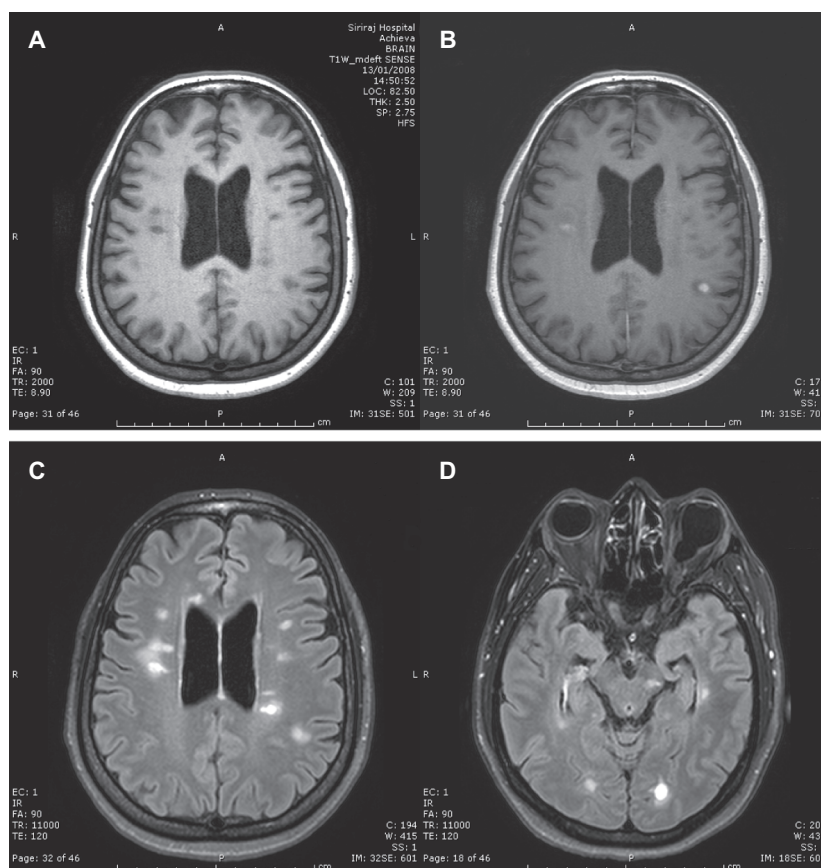


Figure 1. Axial brain MRI of a 44-year-old woman with relapsing–remitting multiple sclerosis. There were multiple hypointense lesions on T1-weighted image (A) and two enhanced lesions on the postgadolinium image (B). Axial FLAIR image showed nine lesions perpendicular to lateral ventricles with juxtacortical involvement (C) and one midbrain lesion (D).



Figure 2. Saggittal spinal cord MRI of a 21-year-old woman with relapsing–remitting multiple sclerosis. There were focal hypointense lesions on T1-weighted image at upper thoracic level (A) which enhanced on the postgadolinium image (B) and focal cord edema was seen on T2-weighted image (C).

Table 1: Site of attack preceding initial brain MRI

Site of attack	Number of patients	Percent
Brain stem	10	27.8
Cerebellum	2	5.6
Optic nerve	7	19.4
Spinal cord	12	33.3
Brain stem and spinal cord	2	5.6
Optic nerve and brainstem	2	5.6
Brain, brainstem and cerebellum	1	2.8
Total	36	100.0

Table 2: Characteristics of brain MRI stratified according to McDonald MRI criteria for DIS*

Characteristic	Number of patients	Percent
≥ 9 T2 lesions	20	55.6
≥ 1 gadolinium enhanced	7	19.4
≥ 3 periventricular	19	52.8
≥ 1 juxtacortical	18	50.0
≥ 1 infratentorial	18	50.0
Brain atrophy	10	27.8
Fulfill McDonald MRI criteria for DIS 2005	18	50.0

* **DIS:** dissemination in space

Brain MRI

Initial brain MRI was performed following an attack at the spinal cord 33.3 %, brainstem 27.8 %, and optic nerve 19.4 %, as shown in Table 1. The median interval from relapse to MRI studies was 2 weeks, and MRI was performed within 4 weeks in 55 % of patients. There were at least nine T₂ lesions 55.6 %, at least one gadolinium-enhanced lesion 19.4 %, at least three periventricular lesions 52.8 %, at least one

juxtacortical lesions 50 %, infratentorial lesion 50.0 %, and brain atrophy 27.8 %. Fifty percents satisfied McDonald MRI criteria for DIS 2005 (Table 2).

Spinal MRI

Sites of recent relapse prior to the initial spinal cord MRI were at spinal cord in 50%, brainstem 16.7%, and optic nerve 12.5% (Table 3). All MRI was performed within 4 weeks of the attack. The

Table 3: Site of an attack preceding spinal MRI

Attack	Number of patients	Percent
Brainstem	4	16.7
Cerebellum	1	4.2
Optic nerve	3	12.5
Spinal cord	12	50.0
Brainstem and spinal cord	2	8.3
Optic nerve and brainstem	1	4.2
Brain, brainstem and cerebellum	1	4.2
Total	24	100.0

Table 4: Level of the spinal cord lesion

Level of lesions	Number of patients	Percent
No lesion	8	33.3
Cervical	4	16.7
Thoracic	8	33.3
Cervicothoracic	4	16.7
Total	24	100.0

Table 5: Comparison of brain MRI findings

Characteristic of brain MRI	Thai MS present	Thai MS previous ¹¹	Collaborative Asian MS ¹⁰	Asian Singapore study ¹³	Western Netherland study ¹⁴
Number reviewed	36	25	101	40	104
≥ 9 T2	55%	35%	53%	-	-
≥ 3 periventricular	52%	56%	43%	55%	73%
≥ 1 juxtacortical	50%	70%	61%	65%	80%
≥ 1 infratentorial	50%	58%	58%	50%	79%
≥ 1 gadolinium enhanced	19%	17%	29%	34%	45%
Fulfill McDonald MRI criteria for DIS 2005	50%	24%	52%	50%	85%

thoracic spinal cord level was most commonly involved (33.3%) as shown in Table 4. Patients with one T₂ lesion accounted for 45.8%, the remaining 5 patients had 2, 3, 5, 6 and 10 spinal lesions, respectively. There were gadolinium enhancement in spinal cord MRI studies in 37.5%, lesions > 2 vertebral body segments (VBs) in 4 patients (16.7%) with a mean length of 1.29 VBs

(range 0-3 VBs), cord atrophy 12.5% and cord swelling 16.7%.

DISCUSSION

In 2006, we reported the characteristics of brain MRI in a small group of patients (25 patients).¹¹ The mean age was 35.4 years old and only one patient was male. Findings from brain MRI were

Table 6: Comparison of spinal cord MRI findings

Characteristic of spinal cord	Thai MS present MRI	Thai MS previous ¹¹	Collaborative Asian MS ¹⁰	Asian Singapore study ¹³	Western Netherland study ¹⁴
Number reviewed	24	13	66	26	104
Predominate level of lesions	Thoracic	Cervical	-	-	Cervical
T2 hyperintense cord lesions	66%	86%	-	82%	-
Enhancing cord lesions	37%	55%	-	40%	17%
> 2 VB* segments	16%	61%	43%	52%	-
Mean length of lesion (VBs)	1.29	-	3.50	-	0.8
Spinal cord atrophy	12%	23%	-	-	-
Spinal cord swelling	16%	53%	29%	-	-

*VB: vertebral body segments

only 24% were compatible with the McDonald MRI criteria for DIS.¹¹ Compared to our present study, the age group was similar. Moreover, female is predominant sex, too. On the characteristics of brain MRI in this study, there were more patients had at least 9 T₂ lesions, more satisfied McDonald MRI criteria for DIS (50% versus 24%) and fewer patients had juxtacortical lesions than the previous Thai study (Table 5).¹¹

Another study in the Asian population by Chong *et al* revealed that only 52% fulfilled McDonald MRI criteria for DIS.¹⁰ Chang *et al* also showed the low sensitivity in McDonald MRI criteria for DIS in Asians¹³ but there is higher sensitivity in Western study (85%)¹⁴ as shown in Table 5. So, the ratio of MS patients who satisfied the 2005 McDonald criteria for DIS is low in the Asian population.^{10,13}

For spinal cord MRI, when compared to previous Thai study, Thai MS patients showed more common thoracic lesions, with less spinal cord atrophy and swelling than the past result. The greater spinal cord atrophy and swelling in our previous study could be due to inclusion of only patients which had a positive spinal cord MRI finding and exclusion of those with no lesion.¹¹

Chong *et al* found that spinal MRI findings in Asians showed cervical level predominance, and the cord lesion was longer than in western patients, with a mean length of lesion of 3.6 ± 3.3 vertebral body segments (VBs).⁷ This result differed from this study, which showed thoracic level predominated and the mean length was 1.29 VBs, range 0-3 VBs (Table 6). The longer cord lesion in previous studies could be due to inclusion of the NMO spectrum disorders. In this study, we excluded AQP4 seropositive-patients even if they were clinically compatible with MS according to the revised McDonald criteria 2005. This could be the reason that the spinal cord involvement was as short as Western reports.¹⁴⁻¹⁷ Since NMO-IgG/AQP4 antibody testing was not available in the previous studies, it is possible that NMO spectrum disorder patients were included then. The antibody detection significantly improved the accuracy of categorizing patients to NMO spectrum disorders or otherwise. Therefore, our study implies that only clinical and imaging criteria are not adequate to differentiate between MS and NMO in Thai patients and, perhaps, in Eastern population as well.

In conclusion, we found that brain MRI had DIS by Revised McDonald criteria (2005) in only 50%. This was similar to reports from Asian countries but it is less than Western population. For spinal

MRI, we found that thoracic lesions were more common, and the spinal cord lesions were as short as in Western patients. Determination of NMO IgG/AQP4 antibody is strongly recommended to avoid inclusion of patients with NMO spectrum disorders who had long extensive spinal cord lesion and contributed to greater length of a spinal lesion.

ACKNOWLEDGEMENT

This study is supported by Siriraj Research Fund.

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