MR Findings of Multiple Sclerosis in Spinal Cord

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Purpose: To analyze the MR imaging features of multiple sclerosis (MS) in spinal cord.

Materials and Methods: Nine MR (magnetic resonance) images of six patients with suspected MS were retrospectively evaluated in active phase (n=6) and inactive phase (n=3) before and after Gadolinium-DTPA administration.

Results: In all patients with clinically active phase, plaques of spinal cord appeared as high signal intensity on T2-weighted image with isointense cord swelling on T1-weighted images. All lesions were enhanced on Gd-DTPA enhanced T1-weighted images. The patterns of enhancement were nodular, circumferential rim-like, and segmental. On follow-up images in 3 patients who became clinically stable, all enhancing lesions disappeared.

Conclusion: MR is a good modality in detection of spinal MS, and Gd-DTPA-enhanced MR is valuable in differentiating active MS from stable MS.

Index Words: Spinal cord, MR Sclerosis, multiple

The advent of MR imaging with its various pulse sequence has facilitated the diagnosis of demyelinating lesions, especially in spinal cord(1, 2). The multiple sclerosis (MS) plaques in spinal cord are usually elongated and have a high signal intensity on T2-weighted images. On T1-weighted image, the lesion sites of the cord show enlarged, normal, or atrophic appearance(2). Acute demyelinating lesions may be indistinguishable from older, chronic lesions on T1- and T2-weighted images without contrast enhancement(3, 4).

Larsson et al. reported differences between active and stable lesions in multiple sclerosis in spinal cord by Gd-DTPA enhanced image(2). The purpose of this study was to describe MR findings of spinal MS in active and stable stages.

SUBJECTS and METHODS

Six patients (2 male, 4 female aged 27 yrs to 54 yrs) with suspected MS in spinal cord were evaluated. The diagnosis was based on the criteria proposed in Bartel classification system as definite(n=2), probable(n=1) and possible(n=3)(5). In all patients, CSF analysis such as oligoclonal band, IgG index and evoked potentials were studied. Each patient underwent a complete neurologic examination, with particular attention given to recent changes in neurologic status. Lesion activity was defined as a recent change in neurologic signs or symptoms(within 4 weeks prior to the study). All patients categorized as having inactive MS had been free of new neurologic symptoms for more than 2 months.

MR studies were performed on 1.5T system using sagittal T1-weighted(500/20, TR/TE), T2-weighted(2500/80) and proton density-weighted(2500/30) images. In addition, the T1-weighted sagittal and axial scanning was done following the intravenous administration of Gd-DTPA(0.1mmol/kg Magnevist). The thickness of slices was 5mm in sagittal plane or 4mm in axial plane, and acquisition matrix was 256 × 256 or 256 × 192. We also included 2 studies of 0.5T MR from outside institution. The MR features evaluated included the site and extent of involvement, number of previous lesions, signal intensities on T1- and T2-weighted images and enhancement patterns of the lesions after Gd-DTPA administration.

Follow-up MR imagings in three patients were
obtained 2 months after their initial MR studies. Brain MR was performed in 5 of 6 patients.

RESULTS

Clinical data and MR findings of all six patients are summarized (Table 1). Plaques in spinal cord were detected in cervical (n=2), thoracic (n=3) and both cervical and thoracic (n=1) spinal cords (case 2). In all 6 patients with clinically active stage, lesions appeared as high signal intensity on proton density- and T2-weighted image. No definite abnormal signal intensity within spinal cord on T1 weighted image, but findings of cord swelling were shown. All lesions were enhanced on Gd-DTPA enhanced on T1 weighted images. The patterns of enhancement were nodular (n=2) (Fig. 1, 2), circumferential rim-like (n=3) on axial image, or segmental appearance (n=1) (Fig. 3) on sagittal image. Gd-DTPA enhanced lesions were smaller than their corresponding lesions on T2 weighted image.

In 3 patients, follow-up examinations were performed after 2 months. On T1 weighted images, normalized cord size in case 2, 5 and mild cord atrophy at the same level of previous lesion site in case 4 were seen. On T2 weighted images, high signal intensity disappeared in case 2, but high signal intensity remained in case 4 and 5. However, contrast enhanced lesions disappeared in all cases (Table 1).

There were multiple intracerebral plaques in 2 of 5 patients who underwent brain MR imaging (case 4, 6). No significant symptoms due to brain lesions occurred in case 6, but bilateral sudden visual loss was seen in case 4.

DISCUSSION

MS is an inflammatory disease of unknown etiology that involves mainly white matter. It involves women more often than men, usually affecting adults between 20 and 40 years in age. Clinical characteristics of the disease are chronic relapsing course and remitting neurologic signs and symptoms. The diagnosis is based on history, neurologic examination, and laboratory tests including CSF analysis and evoked potentials. CSF analysis, including measurement of IgG and CSF electrophoresis for the detection of oligoclonal bands, may be helpful to the diagnosis of MS, but not specific (6). Using the Bartel method, three

**Table 1. Summary of Patients Data and MR Findings.**

<table>
<thead>
<tr>
<th>Pt/No.</th>
<th>Age/Sex</th>
<th>Bartel Criteria</th>
<th>Duration of disease (month or year)</th>
<th>Laboratory • Oligoclonal bands • IgGIndex • Evoked potential</th>
<th>Clinically active or stable</th>
<th>T1/T2</th>
<th>T1-Gd</th>
<th>Cord size</th>
<th>Brain involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 35/M</td>
<td>possible</td>
<td>1 mo</td>
<td>• (+) • pathologic • pathologic</td>
<td>active</td>
<td>iso/high</td>
<td>yes</td>
<td>swelling</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>2. 50/M</td>
<td>probable</td>
<td>5 mo</td>
<td>• (-) • normal • pathologic</td>
<td>active</td>
<td>iso/high</td>
<td>yes</td>
<td>swelling</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>3. 27/F</td>
<td>possible</td>
<td>3 yr</td>
<td>• (-) • normal • pathologic</td>
<td>stable</td>
<td>iso/iso</td>
<td>no</td>
<td>normal</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>4. 40/F</td>
<td>definite</td>
<td>3 yr</td>
<td>• (+) • pathologic • pathologic</td>
<td>active</td>
<td>iso/high</td>
<td>yes</td>
<td>swelling</td>
<td>multiple</td>
<td></td>
</tr>
<tr>
<td>F/U(2 months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>F/U(4 months)</td>
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<tr>
<td>5. 54/F</td>
<td>possible</td>
<td>7 yr</td>
<td>• (-) • normal • pathologic</td>
<td>active</td>
<td>iso/high</td>
<td>yes</td>
<td>swelling</td>
<td>no study</td>
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<td>F/U(2 months)</td>
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<td>F/U(4 months)</td>
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<td>6. 51/F</td>
<td>definite</td>
<td>5 mo</td>
<td>• (-) • pathologic • pathologic</td>
<td>stable</td>
<td>iso/high</td>
<td>yes</td>
<td>swelling</td>
<td>multiple</td>
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yes = enhanced F/U = follow-up no = not enhanced

Fig. 1. Case 1: 35-year-old male patient with clinically active myelopathy.
a. Sagittal T1-weighted image shows focal expansion of spinal cord (arrow) at T1-T2 level.
b. Axial T2-weighted image shows a high signal intensity within the spinal cord (arrow).
c. On Gd-DTPA enhanced axial T1-weighted image, nodular enhancement is noted at posterior portion of the swollen spinal cord at T1-T2 level (arrow).

Fig. 2. Case 2: 50-year-old male patient with progressive paraparesis and numbness on the lower leg.
a. Sagittal T1-weighted image shows focal spinal cord swelling at T3-T6 level.
b. Sagittal T2-weighted image shows high signal intensity within the spinal cord at the same level.
c. After Gd-DTPA enhancement, a nodular enhancement is noted in the central portion of the swollen spinal cord (arrow).

On follow-up MR study 2 month later, the lesions were completely disappeared (not shown). The patient recovered completely from the initial myelopathy.

Criteria must be met before the diagnosis of multiple sclerosis can be considered “definite”: (1) history of neurologic symptoms with relapse and remission, (2) evidence of two or more anatomically separate lesions in the central nervous system obtained by clinical examination, electrophysiologic tests, or imaging techniques, and (3) evidence of immunologic disturbance involving the central nervous system revealed by a demyelinating spinal fluid profile. Diagnosis of MS may be considered “probable” when there is evidence of two separate lesions in the central nervous system and when a patient satisfies only one of the two remaining essential criteria. Finally patients with evidence of a single lesion or clinical deficit, but satisfying one or both the remaining essential criteria, would be diagnosed as “possible” multiple sclerosis(5). Our cases were classified as definite (n=2), probable (n=1) and possible (n=3).

Pathologically, spinal cord plaques were characterized by their elongated configuration along the long axis of spinal cord. Plaques within the cord preferentially occur in the dorsal and lateral segments(7). In our cases, plaques had elongated configuration along the long axis of spinal cord. Most acute demyelinating
lesions are accompanied by edema due to increased permeability of blood brain barrier and this results in transient swelling of cord at the level of the lesion(8, 9), as was seen in all of our 6 patients. On Gd-DTPA enhanced images, most enhancing lesions were smaller than corresponding lesions on T2-weighted images and were shown mainly as nodular or circumferential rim-like enhancement. Lesions of spinal MS are reported to be located at all levels of spinal cord with a propensity for cervical cord(10, 11). In our study, there was no particular propensity for cervical cord.

On follow-up images, no enhancement was noted in all 3 patients who had no new neurologic symptoms.

Edwards et al. reviewed the brain MR examinations of 10 adults patients with isolated spinal cord symptoms and they found typical MS lesions in six of 10(12). In a study by Honig et al., 21% of MS patients with spinal cord abnormality had normal findings in brain MR study(13). In our study, as there were multiple intracranial plaques in 2 of 5 patients, rate of brain involvement was lower than other studies. If a patient is suspected of having spinal cord MS, it is probably most reasonable to perform a brain MR to screen for asymptomatic multifocal disease in addition to scanning the spinal cord(12).

In conclusion, MR is valuable in detection of spinal MS lesions. Especially, MR with Gd-DTPA may be able to separate active lesions from stable lesions and MR is a good modality for evaluation of disease progression and effect of treatment.

REFERENCES

척수 다발성 경화증의 자기공명영상 소견

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목적: 척수에 생긴 다발성경화증의 자기공명(MR) 영상에서의 소견 및 병의 진행과정에 따른 MR상 변화양상을 알아보고자 하였다.

대상 및 방법: 임상소견, 신경학적검사, 혈청 및 척수액검사, 유발검사로 척수 다발성경화증이 의심되는 6명에서 MR영상을 후향적으로 분석하였다. 영상의 분석은 병변의 위치, 신호강도, 모양, 조영증강 정도 등을 중심으로 분석하였다.

결과: 침범부위는 경추 (2예), 흉추 (3예), 흉추경추를 동시에 침범 (1예) 였다. 임상적으로 활동기인 6예 모두에서 T1강조영상에서는 신호강도 변화없이 척추팽창소견만 있었고, T2강조영상에서는 병변부위가 고신호강도로 관찰되었고, 모든 병변이 조영증강을 보여주었다. 치료결과는 임상적으로 안정기가 된 3개의 추적검사시 병변부위가 조영증강이 되지 않았다.

결론: MR영상은 척수다발성경화증 진단과 병의 진행과정 및 치료효과 판단에 도움이 될 것으로 사료되며, 특히 조영증강 MR영상은 활동기와 안정기 병변의 감별에 도움이 될 것으로 생각된다.
제3회 Radiologic – Pathologic Correlation(AFIP) 강좌 안내

일 시 : 1994년 7월 30일(토) ~ 31일(일)
장 소 : 고려대학교 인촌기념관
평 점 : 11점
등 록 비 : 사전등록 전문의 40,000원 전공의 20,000원
 현장등록 전문의 50,000원 전공의 30,000원

7월 30일(토)
14:00 - 15:00 Intracranial Hemorrhage Anne G. Osborn, M.D.
15:00 - 16:00 MRI–Pathologic Correlation of Liver Tumors Pablo R. Ros, M.D.
16:00 - 17:00 Diffuse Diseases of the Liver Pablo R. Ros, M.D.
17:00 - 18:00 Fundamental Concepts of CT and MRI in Evaluation of the Musculoskeletal Neoplasm Mark D. Murphey, M.D.

7월 31일(일)
08:00 - 09:00 Common Chondroid Lesion of the Musculoskeletal System Mark D. Murphey, M.D.
09:00 - 10:00 Common Soft Tissue Neoplasms in and about Joints Mark D. Murphey, M.D.
10:00 - 11:00 Imaging of Pancreatic Neoplasms Pablo R. Ros, M.D.
11:00 - 12:00 Practical Approach to Mesenteric/Omental Masses Pablo R. Ros, M.D.
12:00 - 13:00 Lunch
13:00 - 14:00 Infections of the Brain and its Linings: Radiologic–Pathologic Correlation Anne G. Osborn, M.D.
14:00 - 15:00 Cranial Nerve Imaging: Anatomic/MR Correlation Anne G. Osborn, M.D.
15:00 - 16:00 Radiographic Assessment of Joint Replacement Mark D. Murphey, M.D.

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