CASE REPORT

Diffusion Magnetic Resonance Imaging May Provide Prognostic Information in Osmotic Demyelination Syndrome: Report of a Case

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Osmotic demyelination syndrome (ODS) is a neurological disorder that can occur with hyponatremia or after its rapid correction, which is known to cause “central pontine myelinolysis” (CPM). Several reports indicate that it can also affect extrapontine brain areas (extrapontine myelinolysis; EPM) (4). The pathogenesis of this disorder is still unclear. ODS is usually attributed to electrolyte imbalance, particularly to profound hyponatremia and its improperly rapid correction (>12 mEq/L per 24 h) (5). Clinical features include upper motor neuron signs, spastic quadripareisis, pseudobulbar palsy, and mental disorders ranging from mild confusion to coma. The outcome ranges from total recovery to death. Magnetic resonance imaging (MRI) is a sensitive technique in the diagnosis of this condition. However, the lesions may take up to 2 weeks to appear on MRI (1). There is poor correlation between the clinical severity and the MRI findings (7). Recovery is variable, it may be slow or rapid, or the damage may become irreversible (4).

Here, we describe a patient with remarkable early recovery which followed a course parallel to the resolution of an abnormal diffusion-weighted MRI parameter.

Case Report

A 35-year-old woman was admitted to the emergency department with hypertension, loss of consciousness and seizure. On admission, her serum BUN concentration was 57 mg/dl, serum creatinine 8.2 mg/dl, serum sodium 114 mEq/l, and potassium 2.9 mEq/l. Her renal ultrasound examination revealed findings consistent with chronic kidney disease. She was diagnosed as having chronic renal failure with fluid overload, and underwent hemodialysis (HD) for 2 h with a dialysate bath of sodium 135 mEq/L and potassium 2 mEq/L. After the first treatment, she recovered clinically. Her BUN level was 32 mg/dl, serum creatinine 4.6 mg/dl, and serum sodium 135 mEq/L. She continued to...
receive hemodialysis for 5 days with normal electrolyte levels. On the ninth day of hospitalization, the patient became dysarthric, confused, apathetic and quadriparetic. Dysarthria and quadriparexia started to improve within a week and neurological signs and symptoms recovered completely within a 2-week period. MRI of the brain was performed on the 9th day of hospitalization when the patient developed neurological symptoms. A 1.5T MR unit was used (Philips Intera Master, Best, The Netherlands) with a dedicated head coil. Diffusion-weighted (DW) imaging (b values with 0 and 1000) with ADC mapping was performed. The ADC values of the affected regions; pons, bilateral caudate nuclei, and putamina as well as the unaffected deep white matter and thalamus were measured with a constant ROI of 0.81 mm². Areas of increased T2 signal in central pons (Fig. 1A) as well as both caudate nuclei and putamina were seen (Fig. 1B). On DW-MRI, increased signal intensity and low ADC values in the putamina and caudate nuclei were seen, indicating restricted water diffusion (Fig. 2A, B). During the follow-up period, MRI was repeated on the first week, first month, and the fourth month using the same technical parameters. Although the ADC values increased, the hyperintense signal on T2-weighted images persisted on images obtained the first week and the first month. An MRI study after 4 months demonstrated normalization of the signal intensity in both the pontine (Fig. 3A) and extrapontine areas (Fig. 3B) and the ADC values (Fig. 4A, B). The follow-up ADC values are summarized in Table 1.

Discussion

The MRI findings of osmotic myelinolysis consist of hyperintense lesions on T2-weighted images. Most of the signal changes are located in the central part of the pons, medulla oblongata, and the mesencephalon. Bilateral symmetric involvement is usually seen in the cerebellar and supratentorial lesions. The pontine lesions exhibit the classical trident shape on axial images. The pontine tegmentum and ventrolateral pons are preserved, which is characteristic of the osmotic demyelination syndrome. These lesions may improve significantly within the first week of treatment, and control MRI studies at 1 month may show complete recovery (6). In our patient, the initial MRI revealed T2-hyperintense lesions in the pons, caudate nuclei, and putamina. DW-MRI revealed increased

Fig. 1. Axial T2-weighted images. A. Symmetrical areas of increased signal in central pons can be seen. Note preservation of the pontine tegmentum and ventrolateral pons. B. Axial T2-weighted images demonstrate bilateral, symmetrical, increased signal on both caudate nuclei and putamina.
signal intensity and low ADC values in these areas ($0.525 \times 10^{-3} - 0.668 \times 10^{-3}$). Decreased ADC values on DW-MRI have been reported previously in patients with CPM and EPM and attributed to cytotoxic edema. DW-MRI allows differentiation of ODS from other diseases which may have similar

Fig. 2. At first MRI. A. DW imaging with b value 1000. B. ADC mapping.

Fig. 3. Axial T2-weighted image (4 months). A complete resolution of the pontine signal intensities can be seen. B. Bilateral caudate nuclei and putamina can also be seen.

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clinical and imaging features, such as tumors, acute disseminated encephalomyelitis, and multiple sclerosis by demonstrating that the edema is of cytotoxic and not vasogenic type (2, 3).

Another remarkable feature of the present case is the clinical recovery period. Early improvement was detected in the quadriparesis. On the 10th day the muscle weakness disappeared, while the dysarthria persisted several more days. At the end of the first week, control MRI was performed and improvement of ADC values was seen. At the end of the fourth month, MRI was completely normal.

It has been reported that among 17 patients with ODS who had undergone hemodialysis, the earliest neurological and radiological (MRI) recovery was detected during one week, but these reports did not describe the DW-MRI findings (6).

In the present case, despite extensive brain lesions on the initial MRI, early and remarkable improvement was detected. The rise in ADC values from the 1st day to the 1st week may reflect the rate of normalization of intracellular hypotonicity. Rapid improvement of ADC values may herald a good clinical recovery.

The present case is the first to demonstrate that ADC values in pontine and extrapontine myelinolysis on DW-MRI may resolve rapidly upon establishment of equilibrium of osmolarity.

DW-MRI, in addition to its contribution in the diagnosis of ODS, can provide valuable prognostic information on this entity which may follow a clinically unpredictable course. Further studies are needed to determine the diagnostic and prognostic utility of DW-MRI.

Table 1. ADC values of follow-up MRIs

<table>
<thead>
<tr>
<th>ADC values</th>
<th>1st day</th>
<th>1st week</th>
<th>1st month</th>
<th>4th month</th>
</tr>
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<tr>
<td>Pons R</td>
<td>0.662 x 10^{-3}</td>
<td>0.784 x 10^{-3}</td>
<td>0.797 x 10^{-3}</td>
<td>0.809 x 10^{-3}</td>
</tr>
<tr>
<td>L</td>
<td>0.668 x 10^{-3}</td>
<td>0.775 x 10^{-3}</td>
<td>0.799 x 10^{-3}</td>
<td>0.812 x 10^{-3}</td>
</tr>
<tr>
<td>Caudat nuclei R</td>
<td>0.549 x 10^{-3}</td>
<td>0.717 x 10^{-3}</td>
<td>0.752 x 10^{-3}</td>
<td>0.798 x 10^{-3}</td>
</tr>
<tr>
<td>L</td>
<td>0.582 x 10^{-3}</td>
<td>0.734 x 10^{-3}</td>
<td>0.749 x 10^{-3}</td>
<td>0.782 x 10^{-3}</td>
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<tr>
<td>Putamina R</td>
<td>0.525 x 10^{-3}</td>
<td>0.690 x 10^{-3}</td>
<td>0.711 x 10^{-3}</td>
<td>0.719 x 10^{-3}</td>
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<tr>
<td>L</td>
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<td>0.708 x 10^{-3}</td>
<td>0.715 x 10^{-3}</td>
<td>0.724 x 10^{-3}</td>
</tr>
</tbody>
</table>

Fig. 4. At the control MRI after 4 months. A. DW imaging with b value 1000. B. ADC mapping.
References


