Spinal Magnetic Resonance Imaging of Spontaneous Intracranial Hypotension in the Early Phase
—Two Case Reports—

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Abstract

A previously healthy 34-year-old woman and a previously healthy 35-year-old woman with spontaneous intracranial hypotension (SIH) presented within 1 week of the onset of symptoms. Brain magnetic resonance (MR) imaging with gadolinium demonstrated no abnormality, whereas spinal MR imaging revealed extradural fluid collection in both patients. Both patients were treated conservatively with bed rest and intravenous hydration. Their symptoms almost completely resolved. We suggest that spinal MR imaging findings of extradural fluid collection can help to establish the early diagnosis of SIH.

Key words: early diagnosis, spontaneous intracranial hypotension, spinal magnetic resonance imaging, extradural fluid collection

Introduction

Spontaneous intracranial hypotension (SIH) was originally described in 1938, and is now defined as a syndrome of low cerebrospinal fluid (CSF) pressure (≤60 mmH2O) that occurs without obvious evidence of dural tear, such as lumbar puncture, head or spinal trauma, or surgical drainage. SIH is characterized by postural headache that improves rapidly in the recumbent position. Other associated symptoms include neck stiffness, nausea and vomiting, diplopia, cranial neuropathies, vertigo, tinnitus, photophobia, nystagmus, and hearing disturbance. SIH has three possible causes: CSF leakage, reduced CSF production, and increased CSF absorption. The similarity of SIH to the post dural puncture headache syndrome supports the idea that CSF leakage in the spine is the cause of SIH.

Brain magnetic resonance (MR) imaging has shown diffuse pachymeningeal enhancement, subdural fluid collection, and downward displacement of the cerebral structures in patients with SIH. The findings of spinal MR imaging include a high incidence of spinal epidural fluid collection. MR myelography can exactly demonstrate the site of the CSF leakage.

We treated two patients in the early phase of SIH, who had none of the typical findings of brain MR imaging.

Case Reports

Case 1: A 34-year-old previously healthy woman had a history of headache associated with nausea and vomiting persisting for 6 days. The headache had started suddenly with back pain, was aggravated by sitting or standing, and relieved by lying down. She had no previous history of dural tear, such as lumbar puncture, head or spinal trauma, or surgical drainage.

Neurological examination and brain MR imaging on admission found no abnormalities. Spinal MR imaging performed before lumbar puncture showed dorsal extradural fluid collection extending from C-3 to T-10 (Fig. 1A). The lumbar puncture revealed low opening CSF pressure of 30 mmH2O, but other studies of the CSF disclosed no abnormalities. Computed tomography (CT) myelography performed on the same day revealed collection of contrast medium in the dorsal extradural space. Brain MR imaging with gadolinium (Gd) on the next day (day 7 after the onset) demonstrated no remarkable findings, such as
Fig. 1 Case 1. Sagittal and axial (T-5) T2-weighted spinal magnetic resonance images performed (A) on day 6 after the onset of symptoms revealing dorsal extradural fluid collection extending from C-3 to T-10 (arrowheads), and (B) on day 21 revealing that the extradural fluid collection had decreased but still remained.

Fig. 2 Case 1. Sagittal and axial T1-weighted brain magnetic resonance images with gadolinium performed (A) on day 7 after the onset of symptoms showing no remarkable findings, and (B) on day 22 showing pachymeningeal enhancement (axial view) and narrowed prepontine cistern (arrow) (sagittal view).

pachymeningeal enhancement, subdural fluid collection, downward displacement of the cerebellar tonsil, or narrowing of the premedullary subarachnoid space (Fig. 2A). Indium-111 diethylenetriaminepenta-acetic acid (DTPA) cisternography performed on day 13 after the onset, 1.5 hours after injection, demonstrated early accumulation of radioactivity in the bladder, but could not accurately localize the site of the spinal CSF leakage.

After conservative observation during 2 weeks of absolute bed rest, her symptoms improved but persisted. Spinal MR imaging performed on day 21 revealed that the extradural fluid collection had decreased but still remained (Fig. 1B). Brain MR imaging with Gd on day 22 demonstrated the typical findings of SIH, such as pachymeningeal enhancement, slight subdural fluid collection, and narrowed prepontine cistern (Fig. 2B). Further 2 weeks of strict bed rest and intravenous hydration were ordered, and her symptoms almost completely resolved.

Case 2: A previously healthy 35-year-old woman presented with a 1-week history of postural headache that improved rapidly in the recumbent position. She had suffered from sudden onset of lumbago before this headache appeared. She had no previous history of dural tear.

Neurological examination found no abnormalities. Brain MR imaging with Gd on admission (day 7 after the onset) found no pachymeningeal enhancement, subdural fluid collection, downward displacement of the brain structure, or decrease in the size of the prepontine cistern (Fig. 3A). Spinal MR imaging before lumbar puncture demonstrated dorsal extradural fluid collection extending from T-1 to T-10 (Fig. 4A). The lumbar puncture revealed depressed opening CSF pressure of 0–10 mmH2O, most likely dry-tap. Indium-111 DTPA cisternography performed on day 14 after the onset, 0.5 hours after injection, demonstrated early accumulation of radioactivity in the bladder, but could not localize the spinal CSF leak. CT myelography performed on the same day revealed extravasation of the contrast medium into the dorsal extradural space.

After conservative observation during absolute bed rest for 2 weeks and intravenous hydration, her
Fig. 3 Case 2. Sagittal and axial T₁-weighted brain magnetic resonance images with gadolinium performed (A) on day 7 after the onset of symptoms showing no remarkable findings, and (B) on day 22 also showing no remarkable findings.

Fig. 4 Case 2. Sagittal and axial (T-5) T₂-weighted spinal magnetic resonance images performed (A) on day 7 after the onset of symptoms revealing dorsal extradural fluid collection extending from T-1 to T-10 (arrowheads), and (B) on day 21 revealing markedly decreased extradural fluid collection.

symptoms almost completely resolved. Spinal MR imaging performed on day 21 demonstrated markedly decreased extradural fluid collection (Fig. 4B). Brain MR imaging with Gd on day 22 demonstrated no abnormality (Fig. 3B).

Discussion

CSF leakage in the spine can be detected by radioisotope cisternography, CT myelography, or spinal MR imaging.¹¹ Radioisotope cisternography, which shows the spinal CSF leakage and early visualization of the kidneys or urinary bladder, allows the diagnosis of SIH, but has a 30% false-negative rate,¹² and early visualization of the urinary system may also occur by accidental injection of the radioisotope into the microvessels.¹³ In our two cases, we failed to detect the spinal CSF leak by radioisotope cisternography, but confirmed accumulation of radioactivity in the bladder. We think that this finding should be considered as a reference. CT myelography is more sensitive but requires spinal tap that may cause deterioration of the symptoms of SIH. Spinal MR imaging is the most convenient and least invasive method for detecting spinal CSF leakage, but is inferior to the others for confirming the site of leakage. However, heavily T₂-weighted MR myelography can clearly demonstrate the site of CSF leakage.⁴

Brain MR imaging with Gd has shown diffuse pachymeningeal enhancement due to venous engorgement, subdural fluid collection, and downward displacement of the brain structures in patients with SIH.³,⁷,⁹ We could not detect abnormal findings by brain MR imaging with Gd performed on day 7 after the onset of symptoms in our two patients. Brain MR imaging on day 22 detected pachymeningeal enhancement and subdural effusion in Case 1, but no characteristic finding in Case 2. The time interval between the appearance of findings on spinal and brain MR imaging is an interesting issue, but needs further investigations with more patients.

Recently, the pathogenesis of SIH has been ascribed to CSF hypovolemia caused by occult spinal CSF leakage.⁵,⁶ Therefore, spinal CSF leakage is the primary step of this disorder, and the most direct indication of SIH in the early phase. In contrast, findings such as pachymeningeal enhancement,
subdural effusion, and sagging of the brain are indirect indications found in the late phase. In our two cases, brain MR imaging with Gd did not demonstrate abnormal findings, but we could detect spinal CSF leakage by spinal MR imaging in the early phase of SIH. Subsequent brain MR imaging revealed some findings in Case 1, when the symptoms still persisted, but not in Case 2, when the symptoms had resolved. Therefore, we suggest that brain MR imaging may not demonstrate any of the characteristic findings in the early phase of SIH, but only with the progress of SIH. We think that SIH had reached the healing stage when repeat brain MR imaging was performed in Case 2.

Spinal MR imaging for identifying spinal CSF leakage may be the most available and least invasive examination for diagnosis of SIH, especially in the early phase. Spinal MR imaging shows a high incidence of spinal epidural fluid collection (more than 80%) in patients with SIH. Furthermore, spinal epidural fluid collection may precede the intracranial findings based on the assumed etiology of SIH.

We chose conservative treatment for our patients because we could not detect the exact site of the CSF leakage. However, if the site of the CSF leakage had been demonstrated, blood patch treatment in the early phase of SIH might be helpful. Social concern about the occurrence of SIH among patients with headache has recently been increasing. If patients show symptoms that suggest SIH, spinal MR imaging is mandatory if brain MR imaging shows no typical findings, especially in the early phase of this rare clinical entity.

References

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