Clinical Usefulness of Magnetic Resonance Cisternography in Patients Having Hemifacial Spasm

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To evaluate the usefulness of MR cisternography fourteen patients that had hemifacial spasm and 20 control patients underwent MR cisternography. All the patients with hemifacial spasm had a confirmed vascular compression after surgery. MR cisternography was performed using a 1.5 tesla superconducting MR magnet in which a 3D (dimensional) heavily T2-weighted turbo spin-echo sequence was used. In 34 randomly selected individuals, we retrospectively determined whether MR cisternography images could be used to evaluate symptoms, and what the benefits of obtaining this image was. The results were correlated with the surgical findings. The sensitivity was 100% and the specificity was 94% in all patients having a hemifacial spasm. The offending vessels were the anterior inferior cerebellar artery (AICA) in six patients cases, the posterior inferior cerebellar artery (PICA) in six, both the vertebral artery and PICA in one, and the vertebral artery in one. All the images showed good resolution and contrast, and also showed the exact correlation between the facial nerve and intracranial vessels in the multiplanar image. The findings of neurovascular compression were well correlated with the surgical findings. We believe that high-resolution 3D MR cisternography is a very useful method for evaluating the neurovascular compression in patients that have hemifacial spasm.

Key Words: Magnetic resonance (MR), vascular studies, Magnetic resonance cisternography, Hemifacial spasm, Offending vessels

INTRODUCTION

Hemifacial spasm is a symptom complex that includes an involuntary, painless spasm of the facial muscles. It is characterized by having a unilateral hyperactive facial nerve dysfunction. The major cause of the hemifacial spasm is a compression of the seventh cranial nerve at its anterior caudal root exit zone (REZ) by vascular loops that may involve the posterior inferior cerebellar artery (PICA), the anterior inferior cerebellar artery (AICA), vertebral artery, or the cochlear artery.

The surgical procedure of choice for patients who do not respond to conservative treatment consists of microvascular decompression. This procedure results in a complete resolution or improvement of symptoms in the majority of cases. Therefore, identification of the offending vessels that are compressing the REZ of the seventh nerve and the detailed anatomy near the surgical field is important in deciding upon a therapeutic plan.

In the past, assessments of patients that have hemifacial spasm consisted of CT and/or angiography. However, both CT and angiography failed to show the relevant portions of the seventh nerve. MR imaging can directly depict the course of the seventh nerve from the brain stem to the internal auditory canal, but sometimes, by using conventional MRI it is difficult to evaluate the exact relationship between the seventh nerve and the vertebrobasilar system because of the relatively low resolution and inadequacy of the slice section of the image plane.

To delineate the neurovascular compression more precisely, we used a 3 dimensional MR cisternography technique with multiplaner sections along the affected facial nerves. Our MR observations were compared with the surgical
findings.

MATERIALS AND METHODS

Fourteen patients having hemifacial spasm who were clinically suspected of having intracranial neurovascular compression were investigated. All the patients received a microvascular decompression procedure. This study group consisted of four men and ten women, who had an average age of 50 years (range, 27-67 years). The control group consisted of twenty patients referred for evaluation of a psychological problem or for treatment of a mild headache. This group consisted of 9 men and 11 women, who had an average age of 52 years (range, 24-70 years).

Examinations were performed using a 1.5 T superconductive magnet with a standard head coil (Gyrosan ACS-NT, Philips, Netherlands). Conventional T1 weighted (TR/TE 500/8msec) and T2 weighted (TR/TE 3500/100msec) axial and coronal images were done. And magnetic resonance cisternography was then performed in which a heavily T2 weighted 3D turbo spin-echo sequence was used to display a reversed image having the following parameters: (TR 4000msec, TE 250msec, FOV 140, 0.7 mm slice thickness, 256 × 256 pixel matrix, echo train length 61, scan time 6 min). We usually obtained axial and coronal images and in some patients we also obtained oblique sagittal or oblique coronal images to delineate the entire course of the facial nerves. All the patients also had MR-angiography (time-of-flight, FOV 180, TR 37 msec, TE 3.2 msec).

We evaluated all the images of 3D MR cisternography taken of the patients with hemifacial spasm, and attempted to determine the practical value of these images. The relationship between the REZ of the seventh cranial nerve and the vertebrobasilar system was studied by comparing 2 categories: no contact (negative), and contact with the REZ or deformity of the REZ and/or pons (positive).

In each case, two investigators who had no information about the patients or the surgical findings independently evaluated the relationship of the vessels to the seventh cranial nerve, and assigned the results to one of the two categories. The results were then compared; indeterminate cases were reviewed, and a diagnostic consensus was reached.

RESULTS

All the images of MR cisternography showed good resolution and contrast. The anatomic correlation between the nerves and blood vessels within the cisternal space was precisely determined. Identification of the facial nerve and vestibulocochlear complex was possible in all patients. A clear delineation of REZ of the facial nerve and intimate blood vessel was also accomplished (Fig. 1). Multiplaner coronal and oblique coronal images, in particular, gave useful information about the degree of compression or deformity of REZ in addition to that obtained from the axial

![Fig. 1. Axial image of MR-cisternography (A) showed the vascular loop (arrow) compressing the left facial nerve root exit zone. Oblique coronal images (B) showed an upward compression of the pons and root exit zone by an intracranial vessel (arrow).](image-url)
slice images (Fig. 2).

In all 14 patients having hemifacial spasm, a neurovascular compression was detected during their surgery. The offending vessels were the anterior inferior cerebellar artery (AICA) in 6 cases (right 4, left 2), the posterior inferior cerebellar artery (PICA) in 6 cases (right 3, left 3), both the vertebral artery and the PICA in one case (left), and just the vertebral artery, in one case (left). There were three false positive cases in the asymptomatic control group (Table 1). All of three false positive cases showed neurovascular contact in the REZ of the facial nerve rather than deformity of REZ or pons.

**DISCUSSION**

Hemifacial spasm is a symptom complex consisting of an involuntary, painless spasm of the orbicularis oculi muscle. It may progress to involve all the facial muscles. It is thought that the hemifacial spasm is related to compression of the facial nerve at the REZ from the brainstem by vascular loops or aneurysms, veins, arteriovenous malformations, and cerebellopontine angle.

![Fig. 2] Axial image of MR-cisternography (A) showed a tortuous left vertebral artery (arrow) compressing the left facial nerve root exit zone. Oblique coronal image (B) revealed the vascular compression of the pons (arrow) with deformity more exactly. In MR angiography (C), the upward elevation of the distal left vertebral artery (arrow) can be seen.

**Table 1. Diagnostic Accuracy of MR Cisternography**

<table>
<thead>
<tr>
<th>MR Cisternography</th>
<th>Patients with hemifacial spasm</th>
<th>Patients without hemifacial spasm</th>
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<tbody>
<tr>
<td></td>
<td>Symptomatic side (n=14)</td>
<td>Asymptomatic side (n=14)</td>
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<tr>
<td>+</td>
<td>14</td>
<td>1</td>
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<tr>
<td>-</td>
<td>0</td>
<td>13</td>
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+contact with the root exit zone of facial nerve or deformity of the pons.
- no contact.
Sensitivity: $14/14=100\%$, Specificity: $51/54=94\%$, Accuracy: $65/68=96\%$.
masses.\textsuperscript{1,3}

In patients who are refractory to medical therapy, microvascular decompression is among the surgical procedures of choice. This procedure entails moving the offending vessel away from the REZ and interposing a nonresorbable spongy material between the vessel and the brainstem. This transposition provides a complete resolution or improvement in the majority of cases.\textsuperscript{5}

In the past, angiography and/or CT had been used to assess patients having hemifacial spasm. In Angiography it is necessary to calculate the position of the REZ of the facial nerve on the basis of surrounding bony structures because it can not demonstrate the soft tissue of brain stem or facial nerve. Another limitation of Angiography is that it can not reveal tumors such as meningiomas and dermoids. CT also has a similar limitation in that there is some difficulty in visualization of the brain stem and the fine nervous structures in the posterior fossa because of beam hardening artifacts occurring in this area. Since both the CT and angiography fail to demonstrate the relevant portions of the seventh nerve, results have been mixed.\textsuperscript{5}

MR imaging can directly depict the course of the seventh nerve from the brainstem to the internal auditory canal. This portion of the seventh nerve is more easily evaluated using MR imaging than with other imaging methods.\textsuperscript{6,9}

Using a conventional 2 dimensional Fourier transformation MR imaging, various methods have been used to identify the compressing artery in patients with hemifacial spasm.\textsuperscript{9} However, in order to obtain a thinner section width for precise anatomic analysis, the resolution of the image was decreased because of the distortion of the S/N ratio.

Previous studies using 3 dimensional MR techniques, such as the 3D fast low-angle shot technique,\textsuperscript{10} the contrast-enhanced 3D spoiled gradient-echo technique,\textsuperscript{11} and the fast imaging with steady-state precession technique,\textsuperscript{12} have also been reported to be useful in identifying the offending artery.

In 1994, El Gammal and Brooks\textsuperscript{3} introduced the use of inverted images of a heavily T2-weighted fast spin-echo pulse sequence to MR cisternography. Contrast and resolution plays an important role in obtaining precise information about cranial nerves and vessels within the cerebellopontine cisterns. MR cisternography is a noninvasive technique that uses in vivo CSF as a contrast material, which travels unaided into the subarachnoid spaces. The 3D image technique makes it possible to get a more thinner width and a high resolution image without a significant loss in S/N ratio. This method is helpful in demonstrating the fine structures within CSF space such as the vertebrobasilar arteries and the cranial nerves.\textsuperscript{13-17}

A similar method to the 3D fast spin-echo technique was used in twenty patients having hemifacial spasm by Hideyuki et al. They obtained good results when they defined precise anatomic information on the preoptic cistern.\textsuperscript{18} We also obtained images that had good contrast and resolution in all patients and high diagnostic values of sensitivity and obtained specificity when we evaluated the neurovascular compression. In the present study, we used multiplanar sections of coronal and oblique coronal images in addition to axial images. This made it possible to get more exact anatomical information. It was also very helpful in understanding the exact relationship between the facial nerve and the intracranial vessels. Coronal and oblique coronal images showed the degree of vascular compression more exactly when the offending vessels had an upward compressing vector to the brain stem or REZ compared to a simple axial 3D image. All the patients with hemifacial spasm had a variable degree of brain stem or REZ deformity caused by offending vessels. This result suggests that a brain stem or REZ deformity can be the major factor that triggers the hemifacial spasm. Further study may be necessary to define their exact correlation.

In conclusion, MR cisternography is a good method to use to obtain high quality images that demonstrate fine anatomic structures in the cerebellopontine cistern. By using multiplaner images including coronal and oblique coronal images, in particular, this imaging technique can be useful for the precise preoperative evaluation of neurovascular compression in patients with hemifacial spasm.
REFERENCES


