MRA Delineation of the Vertebral-Basilar System in Patients with Hemifacial Spasm and Trigeminal Neuralgia

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Summary: Detailed depiction of the vertebral-basilar system is often obscured by other vascular structures on the MR angiogram. A special MR angiography technique that can better delineate the branches of the vertebral-basilar system has been designed and has proved particularly useful in the identification of tortuous vascular branches when they come in contact with the seventh or fifth cranial nerves.

Index terms: Magnetic resonance angiography (MRA); Arteries, basilar; Arteries, vertebral; Magnetic resonance, technique

Vertebral-basilar arteries can not be well studied by ultrasound, and conventional angiography involves an element of risk. MR angiography (MRA) may play a significant role in evaluating basilar artery diseases (such as atherosclerotic change, aneurysm, vascular loop-induced hemifacial spasm, and trigeminal neuralgia). This report describes a special MRA technique for imaging the vertebral-basilar arteries.

Materials and Methods

Five young healthy volunteers and two patients with suspected vertebrobasilar-cranial nerve dysfunction syndromes (one with hemifacial spasm and one with trigeminal neuralgia) underwent MRA, and the studies were performed on a 1.5-T Signa unit (GE Medical Systems, Milwaukee, WI). The patients remained supine, but both shoulders were elevated by 4-inch pads. These allowed the head to extend so that the nose pointed towards the ceiling and the localizer film showed the clivus parallel to the floor (Sagittal Localizer: T1-weighted, TR 500, TE 20; 5-mm skip 2.5; 256 × 128 matrix; 1 excitation; field of view, 24 cm) (Fig. 1). A 3-D time-of-flight MR angiogram was obtained using the following parameters: field of view 20 cm; TR 40, TE 6.9; 256 × 192 matrix; 1 excitation. Scanning time was 4 minutes, 6 seconds. Twenty-eight sections were used, centering at 14. The thickness of the volume was from the clivus anteriorly to the floor of the fourth ventricle posteriorly (Fig. 1). Thickness of individual sections was 1 mm. If the initial center was incorrect, the technologist moved it to encompass the entire basilar artery. Total thickness of the volume was 2.8 cm. Coronal T1-weighted images (TR/TE/excitations, 800/20/1; 256 × 192 matrix; field of view, 20 cm; same superior-inferior offset as the coronal 3-D time-of-flight) covering the area were also acquired.

The collapsed MR angiogram was then superimposed on the T1-weighted image that showed the root entry zone of the seventh and eighth nerves and cisternal portions of the fifth nerves (Figs. 2 and 3). To achieve superimposition, an angio image reconstruction using multiple algorithms tool (IRMA, GE, Milwaukee, WI) was used to obtain a maximum intensity pixel collapse image of only the vertebral-basilar system. Next, a T1-weighted coronal image showing entry of the seventh and eighth nerves was chosen. For the vessels and anatomy to match, the 3-D time-of-flight images and the coronal T1-weighted images had to be centered at the same superior-inferior offset. Then, using a pairwise binary and unary operations on images or groups of images tool (BINOP, GE, Milwaukee, WI), the maximum intensity pixel projection image of vertebral-basilar and the corresponding coronal T1-weighted image were added (Fig. 4).

Results

The intracranial portions of the vertebral-basilar arteries were clearly delineated in all subjects. The superior cerebellar arteries and posterior inferior cerebellar arteries (PICAs) were visible in six subjects. However, the anterior inferior cerebellar arteries could not be identified in any of the subjects. Vascular loop compression of the cranial nerves on the affected side was noted in both of the patients (the left vertebral artery and PICA compressed the root entry zone of the seventh nerve in the patient with hemifacial spasm, and the left basilar artery compressed the cisternal portion of the fifth nerve in the patient with trigeminal neuralgia).

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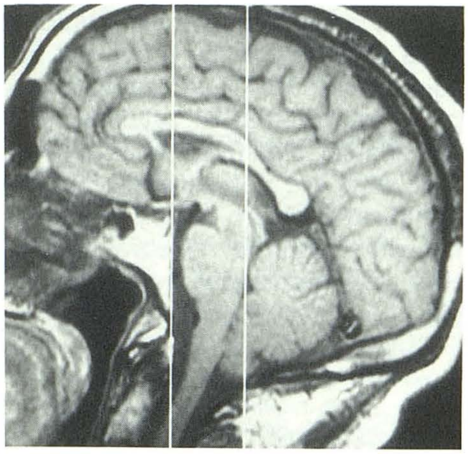

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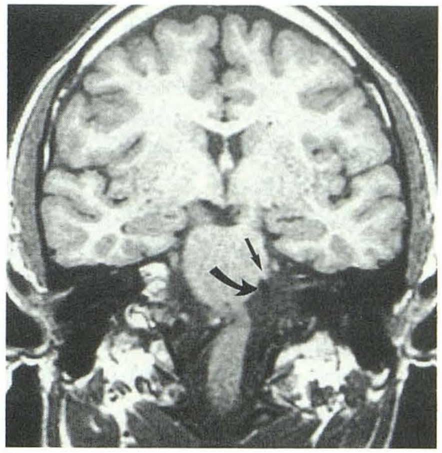

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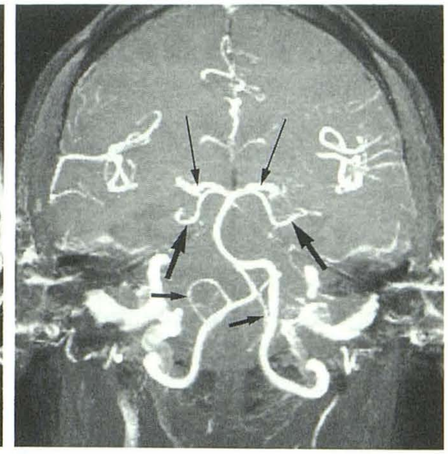

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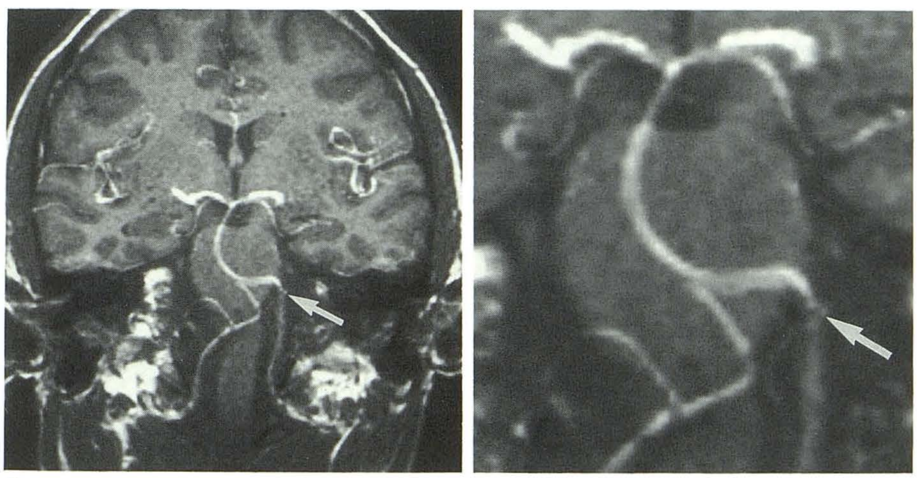
Fig. 1. Sagittal T1-weighted localizer image (500/20/1) shows the clivus is parallel to the floor. The two lines represent the area of coverage from the cortex of the clivus to the floor of the fourth ventricle.

Fig. 2. Coronal T1-weighted image (500/20/1) shows the root entry zone of the left seventh nerve (*arrow*). There is a signal void vascular structure (*curved arrow*) close to the root entry zone.

Fig. 3. Collapsed coronal 3-D time-of-flight (40/7/1) image shows the entire intracranial vertebral-basilar arterial system. The posterior cerebral artery (*long thin arrows*), superior cerebellar arteries (*large arrows*), and posterior inferior cerebellar arteries (*short arrows*) are well seen.



A B

Fig. 4. *A*, Superimposed Figure 3 on Figure 2 shows the origin of left posterior inferior cerebellar artery (*arrow*) with a tortuous left vertebral artery very close to the root entry zone of left facial artery.

B, Magnification (3×) of the regional anatomy of the vertebral-basilar arteries as shown in *A*. Origin of left posterior inferior cerebellar artery (*arrow*) is clearly seen.

Case Illustration

A 50-year-old man with a 3-year history of left hemifacial spasm was admitted for radiologic evaluation. MRA was performed using the above described technique. The images showed a tortuous left vertebral artery (Fig. 3) and the loop of the PICA appeared to impinge on the root entry zone of the left facial nerve (Fig. 4). These MR findings were confirmed during surgical exploration: the origin of the left PICA was found to directly impinge on the root entry zone of the left facial nerve. After vascular decompression, the patient's symptoms resolved.

Discussion

The quality of the MR angiograms of the vertebral-basilar arteries using this technique is excellent. These patients did not have conventional angiograms for comparison. Therefore, the possibility of some inaccuracy of MRA in our subjects cannot be ruled out; a false positive or negative MR angiogram in a significantly diseased vertebral-basilar artery with turbulent flow is a distinct possibility.

Hemifacial spasm and trigeminal neuralgia are frequently due to vascular loop compression of either the vertebral-basilar arteries or their branches (1, 2). The vascular decompression procedure is helpful in alleviating the disease's symptoms. MR can reveal the signal void of the vascular loop on coronal T1-weighted images (3). However, these T1-weighted images cannot easily depict the entire configuration and relative position of the branches of vertebral-basilar arteries vis a vis the cranial nerves. MRA can give three-dimensional information of the vessels, but on routine MRA images the superimposed carotid arteries can impede examination of the vertebral-basilar system. This new technique can focus on the vertebral-basilar system, exclude the intracranial internal carotid arteries, and provide excellent 3-D MR angiograms of the vertebral-basilar artery. Postcontrast MRA may be useful for detecting the small branches of the vertebral-basilar system. Moreover, when superimposed on T1-weighted images, the arteries and their relationship to the regional anatomy of the brain can be examined for signs of disease. It is important to note that tortuous vertebral-basilar arteries usually do not have clinical significance and their coming in contact with the nerves does not always produce a clinical problem. This technique is one method for examining the vertebral-basilar system in patients with hemifacial spasm or trigeminal neuralgia.

References

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