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Comparison of MR Angiography with X-ray Angiography in Patients with Ischemic Cerebrovascular Diseases

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Summary

MRI angiography and x-ray conventional angiography was performed in 10 patients with ischemic cerebral diseases. In 3 patients, MRI angiography showed narrowing or occlusion of main intracranial arterial trunks, but x-ray angiography confirmed these findings only in one patient. In two other patients, narrowing or occlusion was not observed. Also, no narrowing or occlusion was observed on x-ray angiography, when MRI angiography showed normal findings. It was concluded that MRI angiography was sensitive investigation, when intracerebral occlusive disease was suspected.

Introduction

The recent introduction of intracranial magnetic resonance (MR) angiography has enabled non-invasive patient examination[2,4,8,9]. The extent of knowledge regarding MR angiography findings for aneurysms, arteriovenous malformations, arterial occulusions and venous thromboses is rapidly increasing[3,8,10,11]. However, there are very few reports of comparative studies of MR angiography with X-ray contrast angiography for ischemic cerebrovascular diseases[7]. We report 10 cases of suspected cerebrovascular ischemic disease, which were initially examined with MR angiography, and which were subsequently examined with X-ray contrast angiography for confirmation of the MR angiography findings and for determination of the therapeutic strategy.

Subjects and Methods

The subjects were 10 patients who were initially examined with cerebral MR angiography between April, 1991 and April, 1992. In all the patients, some abnormalities were observed with cerebral MR angiogaphy or clinical signs of brain ischemia were noted, and all were then referred for X-ray angiography. Intra-arterial X-ray contrast angiography using Seldinger's method was performed within 7 days after MR angiography in 6 patients and within 2 months in 4. The patients consist of 5 men and 5 women ranging in age from 49 to 73 years old (mean, 64.4 years).

All the patients were studied with a 1.5T superconducting MRI machine (Shimadzu 150X,

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Japan) with 10 mT/m gradients using a routine head coil. MR angiography was performed using 3-dimensional time-of-flight (3DTOF) technique with 50–60 1 mm-thick axial slices, using a spoiled gradient echo sequence which compensates first-order flow in read- and slice-selection direction. Other scan parameters were as follows: Flip angle, 20 degrees; pulse sequence, TR=30 msec, TE=8 msec; field of view, 200 mm; matrix size, 205×256 and two excitations. X-ray angiography was performed via femoral artery catheterization using non-ionic contrast material, and the image was obtained using digital subtraction technique. If a large image was required, the angiogram was

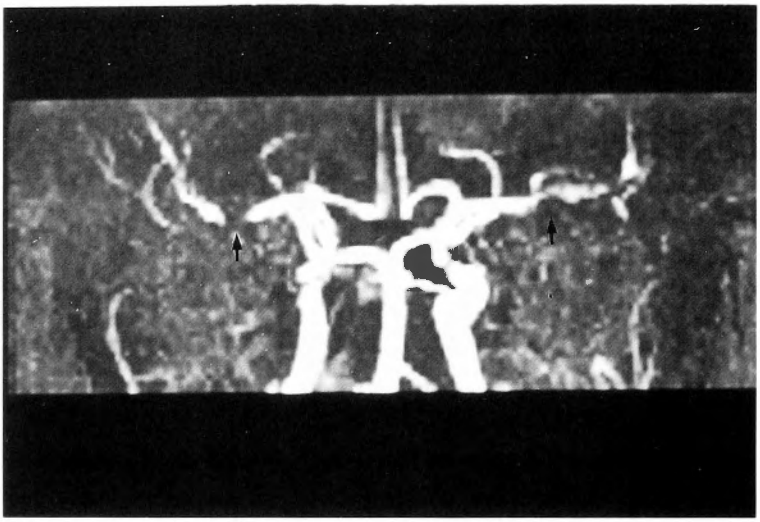

Fig. 1 MR angiography (case 1) reveals occlusion of the right M1 segment and stenosis of the left M1 segment.

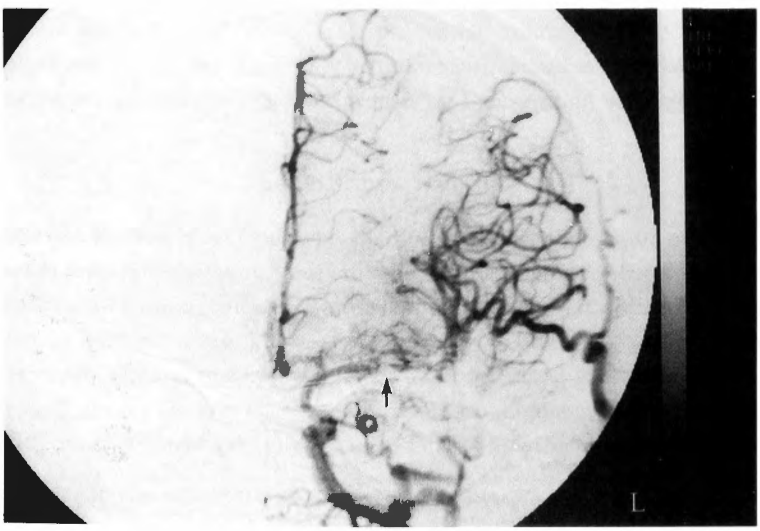

Fig. 2 MR angiography image reveals stenosis of the left C4 segment of the ICA.

taken directly on X-ray film.

Results

Of the 10 patients, 4 showed stenotic change on MR angiography images and 6 normal flow, while 1 showed stenosis on X-ray angiography images and 9 normal arterial images. Four cases in which stenosis was detected using MR angiography are described below.

Case 1. A male patient was admitted because of left cerebral infraction. MR angiography re-

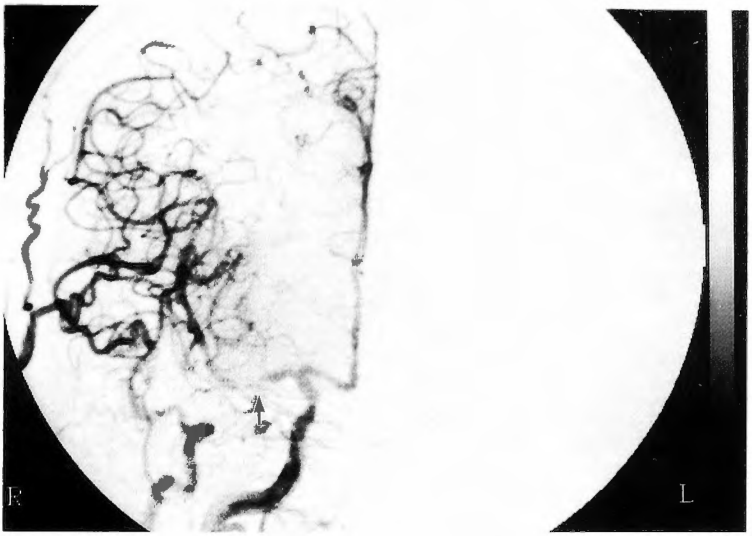

Fig. 3 X-ray angiography (XRA) image revealing approximately 60% stenosis of the left M1 segment.

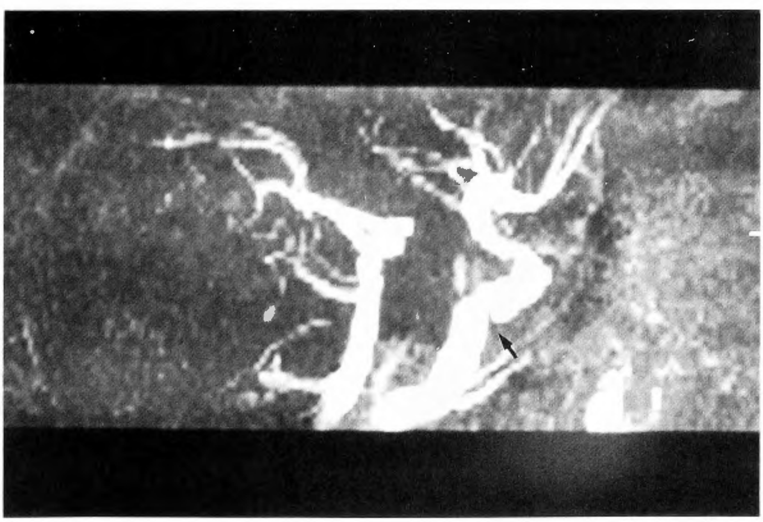

Fig. 4 XRA image revealing approximately 60% stenosis of the right M1 segment.

vealed occlusion of the M1 segment of the right middle cerebral artery (MCA), stenosis of the left M1 segment, and stenosis of bilateral C2 and left C4 segments of the internal carotid arteries (ICA) (Figs. 1 and 4). X-ray angiography performed in order to confirm the results of MR angiography disclosed 60% stenosis of the left M1 segment (Fig. 2), as well as of the right M1 segment (Fig. 3). The left C4 segment was 50% stenotic (Fig. 5). No stenosis of either C2 segment was noted.

Cases 2, 3, and 4, the patients had been admitted because of cerebral ischemia. In case 2, stenotic change of the left M1 segment was noted on MR angiography images (Fig. 6) but stenosis was not observed on X-ray angiography images (Fig. 7). In cases 3 and 4, stenosis of the left M1 seg-

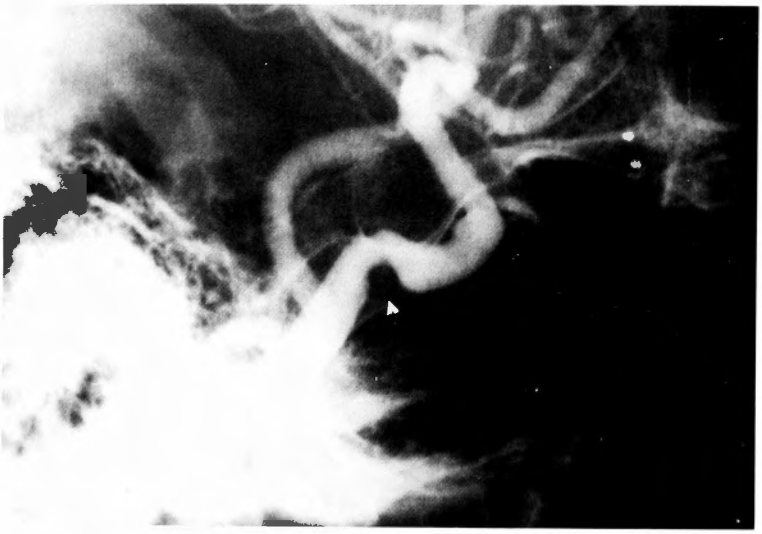

Fig. 5 XRA image (lateral view) reveals approximately 50% stenosis of the C4 segment.

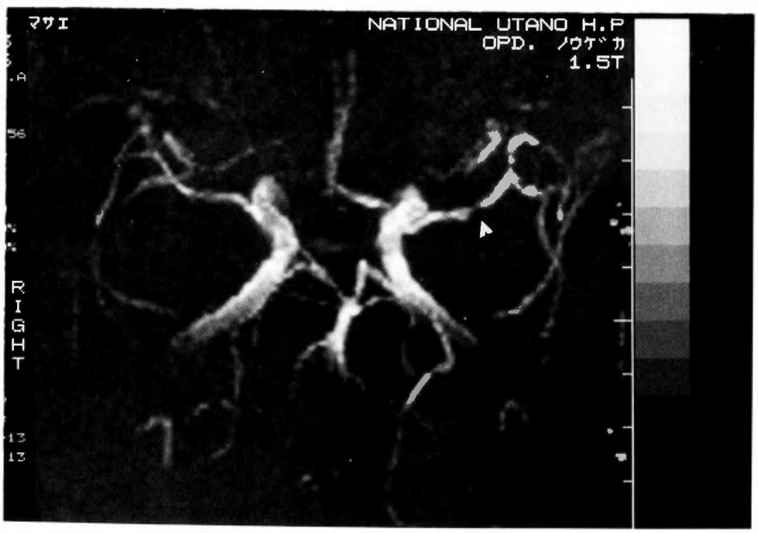

Fig. 6 MRA image in Case 2 reveals stenosis of the left M1 segment.

ment was noted on MR angiography image (Fig. 8), but stenosis was not observed at the same site on X-ray angiography image (Fig. 9).

In cases 5 to 10, normal flow was observed with MR angiography but stenotic vessels were not observed on X-ray angiography images.

Fig. 7 The XRA image in Case 2 fails to demonstrate any stenotic change corresponding to that observed with MRA.

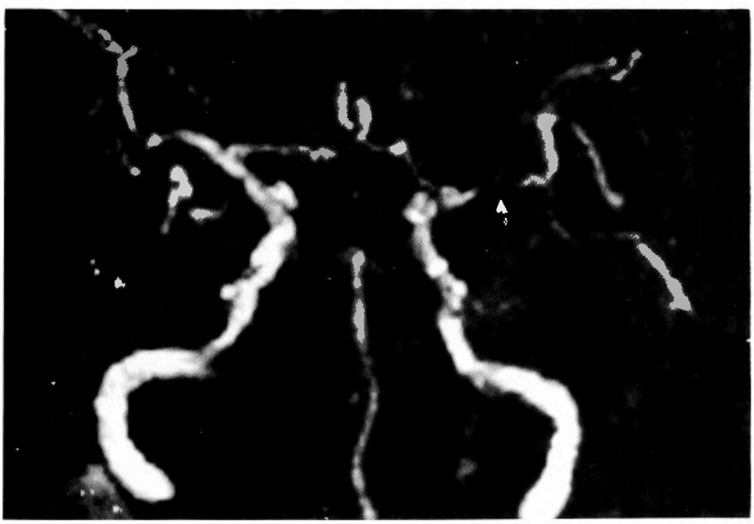

Fig. 8 MRA image in Case 3 discloses stenosis of the left M1 segment.

Fig. 9 the XRA image in Case 3. does not demonstrate any stenotic change corresponding to that observed with MRA.

Discussion

Although there are not a few reports describing MR angiographic techniques, there have been few studies in which MR angiography is compared with X-ray contrast angiography in intracranial arteries[7]. Our results confirm that MR angiography is sensitive in the detection of stenotic changes of the main intracranial arteries. In MR angiography, arterial blood flow is detected inversely as having no signal intensity itself, while surrounding substances show some signal intensity. When the flow rate is somewhat slowed down or the flow is turbid, it shows some signal intensity and, accordingly, the vessel figure diminishes. In other words, the depiction of arteries in MR angiography depends on the speed of arterial laminar blood flow[1,6,7]. In X-ray angiography, on the other hand, the vessel is well visualized even when the local blood flow rate is slow or local blood flow is turbid. Accordingly, MR angiography is more sensitive in the demonstration of arterial flow status than is contrast angiography. This is one explanation for the phenomenon that stenosis is frequently observed in the M1 segment of the MCA with MR angiography, while X-ray angiography demonstrates no stenosis.

Secondly, arterial flow which parallels to the X axis in the slice plane (right-to-left or left-to-right in the method described herein) is better demonstrated by MR angiography than is that which the Y axis (frontal-to-occipital or occfipital-to-frontal). Arterial flow which parallels the Z axis, which crosses the slice plane, is less well visualized. The slice plane was axial (frontal to occipital) in our study. Blood vessels in which the cause of arterial blood flow is coronal are often less well demonstrated. The cause of the M1 segment of the MCA is not always completely horizontal, and any part where it shows coronal course is less well visualized. This may be another factor in the discrepancy between MR and X-ray angiography finding.

MR angiography is thus considered to be diagnostically reliable in the sense that it does not miss a stennotic lesion of the main intracerebral arteries. This feature is particularly appropriate in the screening of out-clinic patients.

Furthermore, MR angiography has the following several merits: it is performed done non-invasively without contrast medium, which favors its use in children and elderly patients; it visualize all the main intracranial arteries rapidly and simultaneously; and, it is appropriate for repeated examination, such as in follow-up study after operation.

Finally, we conclude that MR angiography is very promising as an additional diagnostic method and will reduce the indications for X-ray angiography.

Acknowledgment

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和文抄録

閉塞性脳血管障害患者に対する MR 脳血管撮影法とX 線脳血管撮影法との比較

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我々は閉塞性脳血管障害患者10例に対して MR 脳血管撮影と X 線脳血管撮影を施行し比較したので報告する．MR 脳血管撮影は島津 1.5T 機種を用いた．結果は (1)MR 脳血管撮影，X 線脳血管撮影ともに正常6例があった．(2)MR 脳血管撮影において狭窄変化が認められた4例中，X 線脳血管撮影では1例のみ相応する変化が認められた，しかし3例は相応する変化は認められなかった．(3)MR 脳血管撮影正常でありながら，X 線脳血管撮影異常例はなかった．異常のことより MR 脳血管撮影は閉塞性脳血管障害のスクリーニング検査として十分に敏感であり，かつ有用である．