

MR Imaging of Basilar Artery Occlusion

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Abstract: We studied six patients with basilar artery occlusion using magnetic resonance imaging. Two patients also had arteriography. All had signs consistent with pontine infarction; three had a "locked in" syndrome. Magnetic resonance imaging (five done within 24 h of onset of progression of neurologic symptoms) revealed a linear structure of increased signal intensity in the pontine cistern on T1-weighted parasagittal images and absence of flow void phenomena. Hyperintense signals at various brain stem levels corresponding to the course of the basilar artery were noted on T2-weighted images. Multiple parenchymal abnormalities were noted in the brain stem (six), cerebellum (four), occipital lobes (two), and thalamus (two). Magnetic resonance performed early in the course of basilar artery occlusion is a high-yield, safe procedure and might eliminate the need for arteriography. **Index Terms:** Brain, blood flow—Arteries, occlusion—Arteries, basilar—Magnetic resonance imaging.

Magnetic resonance (MR) imaging is superior to CT in imaging posterior fossa structures. It provides better visualization of arteries, veins, and sinuses, particularly near bony structures (1,2). Magnetic resonance has been reported to be superior to CT in detecting brain stem and cerebellar infarction (3-6). Although transcranial Doppler and dynamic CT might prove in the future to be useful, definitive diagnosis of acute vertebral or basilar artery occlusion still requires cerebral arteriography.

We previously reported MR findings in three patients with basilar artery occlusion who were studied within 24 h after onset or latest progression of neurologic symptoms (7). Occlusion of the basilar artery, as shown by the absence of flow void on axial MR, was seen as early as 90 min after the onset of symptoms. To further evaluate the usefulness of MR in the diagnosis of basilar artery occlusion, we describe the course and MR findings of six additional patients and provide arteriographic correlation of MR abnormalities.

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MATERIALS AND METHODS

Six patients with presumed basilar artery occlusion were admitted between October 1987 and July 1988. All had complete neurological and medical examinations by at least two of the authors. All had CT within 24 h of stroke onset. The CT images were obtained without contrast enhancement using a Siemens DRH unit (Iselin, NJ, U.S.A.) with 8 mm thick axial slices. Five had MR examinations within 24 h, and the other within 72 h of onset of stroke. All MR examinations were performed with a 0.5 T Picker International superconductive unit (Highland Heights, OH, U.S.A.). Parasagittal T1-weighted [repetition time (TR) 350-600 ms, echo time (TE) 20-26 ms] (T1W) and axial and coronal T2-weighted (TR 2,000-2,300 ms, TE 80-100 ms) (T2W), 5 mm thick images were obtained. Extra pulse sequences with various slice thickness and oblique angle cuts were also obtained in some cases. Two patients had arteriography, including arch and vertebral artery injections. Neuroradiologic studies were reviewed independently by a neuroradiologist and two neurologists.

The MR criteria used to diagnose infarction, described previously, included an area of decreased signal intensity on T1W images and an area of increased signal intensity on T2W images in the same location (4-6). The MR criteria indicating basilar

artery occlusion were the presence of a linear structure isointense with the brain stem in the pontine cistern on T1W parasagittal or coronal images and the lack of flow void phenomena with an area of hyperintensity on T2W axial images corresponding to the course of the basilar artery (7).

RESULTS

Six patients, four women and two men, were evaluated. Their mean age was 64 (range 32–83) years. All had arterial hypertension, two had diabetes mellitus, two had coronary artery disease, and three had a previous history of tobacco use. One patient had two previous infarctions (one left occipital, one left cerebellar) and one had a previous episode of amaurosis fugax. Table 1 summarizes the clinical presentation and neuroradiologic studies of these patients. One patient (Case 3) died 2 months following hospital discharge. Postmortem examination was not obtained. The two patients who had arteriography are described below.

CASE REPORTS

Case 4

A 32-year-old woman developed dysphagia, dysarthria, bilateral visual loss, and decreased hearing over a 4 day period, at which time she was transferred to the University of Iowa Hospitals. On admission she was obtunded and mute, but able to follow simple commands. She had

a left gaze paresis, skew deviation, and impaired vertical gaze with horizontal and rotatory nystagmus. Corneal reflexes were depressed bilaterally. She had bifacial paresis, an absent gag reflex, and a flaccid right upper extremity. Muscle stretch reflexes were absent throughout and she had bilateral Babinski signs. Both CT and MR were done within 24 h and arteriography 5 days after stroke onset. Magnetic resonance demonstrated bilateral basis and brachium pontis and left cerebellar infarctions (Figs. 1 and 2). Angiography confirmed a basilar artery occlusion (Fig. 3).

Case 5

A 63-year-old woman with a history of diabetes mellitus, coronary artery disease, congenital Duane syndrome, and right eye blindness presented after the sudden onset of nausea, vomiting, vertigo, and right arm and leg weakness. On examination she had a right relative afferent pupillary defect, bilateral ptosis with decreased ocular abduction, and spontaneous right beating horizontal nystagmus. She had a right hemiparesis, hemisensory deficit, and a right Babinski sign. The CT scans showed a calcified sphenoid-sellar mass. Magnetic resonance, done within 24 h of symptom onset, showed a suprasellar-sphenoid mass, a left pontine infarct, and absence of flow void in the area of the basilar artery (Figs. 4 and 5). Arteriography done the day following admission showed a basilar artery occlusion at the level of the anterior inferior cerebellar artery (Fig. 6). Eight days after the onset of symptoms, she had resection of her craniopharyngioma tumor. Postoperatively she developed complex partial seizures and progression of her neurologic deficits to a flaccid asymmetric quadriplegia with bilateral Babinski signs, thalamic infarction, and extension of her pontine infarction.

TABLE 1. Clinical presentation and neurological studies of patients

Case no.	Age (yrs)/sex	Symptoms/signs	CT	MR	Angiography
1	83/M	“Locked in” syndrome	Old L. occipital and cerebellar infarctions	Bilateral pontine infarctions, BAO	ND
2	76/F	L. gaze and vertical gaze paresis, rotatory nystagmus, L. hemiparesis, R. hemisensory deficit, dysmetria	R. occipital infarction	R. occipital, L. pontine, L. cerebral peduncle, and L. cerebellar infarction, BAO	ND
3	65/M	“Locked in” syndrome	Normal	Bilateral pontine infarctions, BAO	ND
4	32/F	L. gaze and vertical gaze paresis, nystagmus skew deviation, bifacial paresis, R. arm monoplegia	Normal	Bilateral cerebellar pontine infarctions, BAO	BAO and occlusion of L. vertebral and subclavian artery
5	63/F	R. gaze paresis, bifacial paresis, absent gag, quadriplegia, R. hemisensory deficit	Suprasellar mass	L. pontine infarction, BAO	BAO at AICA level
6	64/F	“Locked in” syndrome	Multiple infarction thalamus, pons, and cerebellum	Infarction in both thalami, pons, cerebellum, BAO	ND

BAO, basilar artery occlusion; AICA, anterior inferior cerebellar artery.



FIG. 1. Sagittal T1-weighted MR image shows faint isointense linear structure (arrow) along the course of the basilar artery in the pontine cistern.

DISCUSSION

The basilar artery has a relatively constant course, beginning at or slightly below the pontomedullary junction and stretching the length of the pons, tapering to its termination at the pons-midbrain junction. Kubick and Adams (8), in their classic paper, described 18 patients with basilar artery occlusion including postmortem examination of the basilar artery and brain stem pathology. Atherothrombosis was the main etiology of arterial occlusion in these patients. Atherosclerosis of the

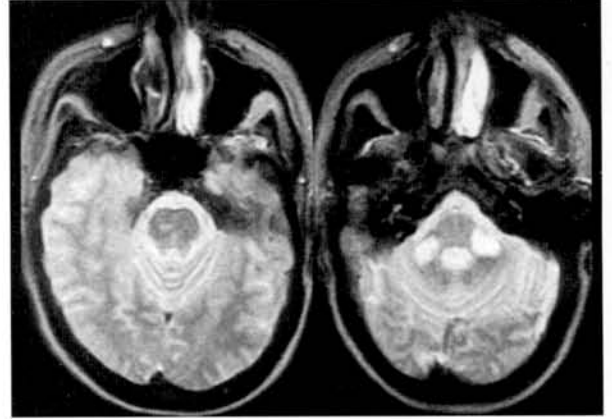


FIG. 2. Axial T2-weighted MR image at the level of the pons shows absence of basilar artery flow void phenomena and areas of abnormal signal intensity in the brachium pontis bilaterally (right) and pontine tegmentum (left).

basilar artery most often leads to occlusion of the proximal basilar artery near the origin of the anterior inferior cerebellar artery branches (9). Rarely basilar artery occlusion occurs from propagation of a vertebral artery "clot," as it did in one of our patients. Occlusion may occur suddenly, but most often the neurologic deficits develop gradually. Progression of the deficit often continues for 24-48 h, and sometimes as long as 7 days (10). The clinical course and outcome are most likely related to the availability and development of collateral circulation. The "locked in" syndrome may occur with extensive basis pontis infarction, as was seen in three of our patients. Because of the distressing outcome, and in an effort to improve management of these patients, it is essential to confirm a diagnosis of basilar artery thrombosis as soon as possible after onset.



FIG. 3. Lateral digital intraarterial subtraction angiogram demonstrates basilar and left vertebral artery occlusion.

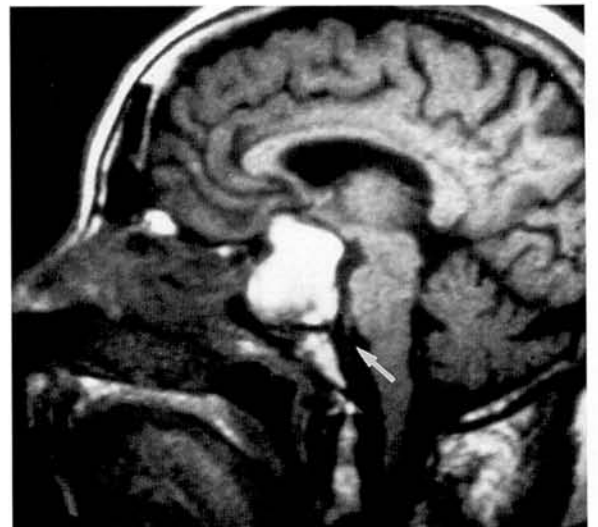


FIG. 4. Sagittal T1-weighted MR image shows a linear structure with a mixed signal intensity along the course of the basilar artery in the pontine cistern (arrow) and a large area of increased signal intensity in the suprasellar region.

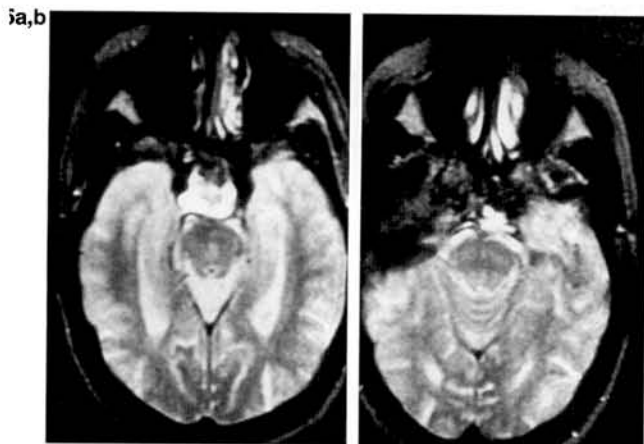


FIG. 5. Axial T2-weighted MR image at the pontine level shows absence of flow void phenomena of the basilar artery (a) and areas of hyperintensity in the midpons (b).

In the past, cerebral arteriography has been the only method to document basilar artery occlusion. However, this invasive procedure can be risky, as patients with basilar artery occlusion are often clinically unstable and there is a possibility of further clot propagation. Transcranial Doppler ultrasound may detect basilar artery stenosis or occlusion, but an absent signal may reflect technical problems (11,12).

Magnetic resonance has been shown to be superior to CT in imaging normal posterior fossa structures owing to the absence of linear bone artifact, good gray-white matter differentiation, multiplanar image capabilities, good visualization of vascular structures, and the availability of different pulse sequences (1). Magnetic resonance is also superior to CT scans in the early detection of brain stem and cerebellar strokes including medullary infarctions (3-7). Changes may be seen on T2W and T1W images within 24 h. A dichotomy has been reported between clinical signs and T2W image abnormalities, suggesting it is difficult to differentiate infarction from edema early after stroke onset (4). The earliest abnormality on MR in patients with basilar artery thrombosis is the absence of flow void on axial T2W images, which may be seen within 90 min of onset of symptoms (7). This has also been described with vertebral artery occlusion (2). The bas-

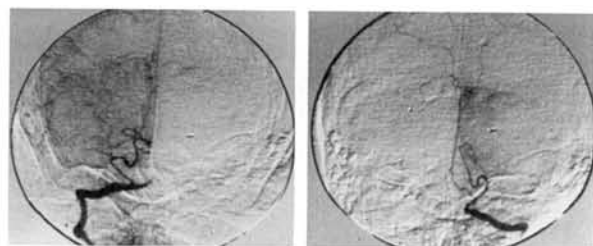


FIG. 6. Digital intraarterial subtraction angiography (anteroposterior view) shows basilar artery occlusion at the level of the anterior inferior cerebellar artery.

ilar artery thrombus is also seen well on T2W sagittal and coronal images as an area of iso- or hyperintensity. A case of basilar artery occlusion with MR and angiographic findings similar to those in our cases has been reported by Baker and Carr (13).

One potential problem in obtaining MR in patients with basilar artery occlusion is the current length of the procedure. These patients often have progressive neurological and respiratory deficits, and it is difficult to monitor these parameters during the scanning process. Research in this area has been encouraging, and most likely shorter imaging time and monitoring equipment will become available in the near future, eliminating this concern.

In conclusion, MR is an excellent noninvasive method to image basilar artery occlusion with brain stem infarction and is clearly superior to CT. Abnormalities may be seen within 24 h of symptom onset. Arteriography revealing basilar artery occlusion correlates with abnormal prepontine signals on T1W sagittal and coronal images. Magnetic resonance, if performed early in patients with suspected basilar artery occlusion, may avoid the need for arteriography and make earlier therapeutic intervention possible.

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