

Paroxysmal dysarthria and ataxia after midbrain infarction

M. Matsui, MD, PhD; H. Tomimoto, MD, PhD; K. Sano, MD; K. Hashikawa, MD, PhD;
H. Fukuyama, MD, PhD; and H. Shibasaki, MD, PhD

Abstract—The authors describe a patient who showed paroxysmal dysarthria and right-limb ataxia after midbrain infarction. SPECT imaging showed marked hypoperfusion in the left parietal lobe while the patient was having frequent paroxysmal attacks. After treatment with phenytoin, the symptoms and hypoperfusion in SPECT imaging improved. The authors conclude that dysfunction of the cerebellothalamocortical pathway after midbrain infarction may cause paroxysmal dysarthria and ataxia.

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Paroxysmal dysarthria and ataxia are characterized by sudden onset, stereotyped patterns, short duration, and frequent repetition. These symptoms have been reported in multiple sclerosis (MS)¹⁻³ but are rarely seen in other neurologic diseases.⁴ In previous reports, management with carbamazepine was effective for this condition.^{3,5} However, the pathophysiologies of paroxysmal dysarthria and ataxia remain unknown. We report here a patient who showed paroxysmal dysarthria and ataxia after midbrain infarction. Treatment with carbamazepine or phenytoin was effective for this patient. SPECT imaging showed marked hypoperfusion in the parietal lobe contralateral to hemiataxia during the period of frequent paroxysmal attacks. Functional reduction of neuronal activity in the parietal cortex resulting from midbrain infarction may cause paroxysmal dysarthria and ataxia.

Case report. A 76-year-old man noticed diplopia and gait disturbance in November 2002. The following day, his wife noticed dysarthria and more pronounced gait disturbance. He was then admitted to Kyoto University Hospital. He had a history of diabetes mellitus, hyperlipidemia, and polyneuropathy. The onset of polyneuropathy had been diagnosed 30 years earlier. Neurologic examination showed mild dysarthria and right-limb ataxia. Although a slight weakness of the left inferior rectus muscle was seen, there was no apparent ocular tilt reaction. There was muscle weakness and wasting in the distal muscles of all extremities. He also showed decreased touch and temperature sensation in the distal portion of all extremities and decreased vibration and position sensation in the lower extremities. Deep tendon reflexes were absent. Mini-Mental State Examination score was 29 of 30. Cranial MRI showed a high intensity area in the left midbrain on T2-weighted (figure 1A) and diffusion (figure 1B) images. This lesion involved left red nucleus and left superior cerebellar peduncle, but the cerebral peduncle was spared. MR angiography did not indicate any apparent stenosis in the major vessels. In the left

vertebral artery, however, a high intensity spot was found on T2-weighted axial image and was thought to be a mural thrombus (data not shown). Together with the present history and neurologic findings, midbrain infarction was diagnosed. Therefore, we administered aspirin (orally, 162 mg/day). Four weeks after onset, he was discharged without any residual symptoms.

Two weeks after discharge, he noticed repeated episodes of diplopia and dysarthria. Each episode lasted 10 to 20 seconds. Initially episodes occurred approximately once every hour, but as the episodes became more frequent, he was admitted to our hospital again. Neurologic examination on readmission revealed no abnormality except for the paroxysmal episodes, during which right-limb ataxia and dysarthria were seen (figure 2A). Nose-to-finger and heel-knee tests demonstrated apparent dysmetria on the right side persisting for 10 to 20 seconds. He could not continue to walk during the attacks. Paroxysmal dysarthria also lasted 10 to 20 seconds during the attacks. The degree of dysarthria and ataxia during these attacks was more intense than that observed just after stroke. No abnormalities were noted in the eye movements during the attack. One week after the development of the paroxysmal episodes, the frequency of the attacks increased to once every 2 minutes. An IV injection of phenytoin (250 mg) completely suppressed the attacks. Carbamazepine (orally, 200 mg/day) was also effective but was discontinued because of dizziness. Therefore, the patient was given phenytoin (orally, 300 mg/day), resulting in complete suppression of the attacks. Laboratory examination showed a normal blood cell count, liver and renal functions, and serum electrolytes. Fasting blood sugar was 136 mg/dL. CSF showed normal cell count, protein content, and immunoglobulin G index (0.45). Myelin basic protein and oligoclonal band in the CSF were negative. Lactate in the CSF was 15.7 mg/dL (8.7 to 13.5 mg/dL), and pyruvate was 1.02 mg/dL (0.37 to 0.75 mg/dL). However, genetic analysis of mitochondrial genomes did not show any point mutations indicative of myopathy, encephalopathy, lactic acidosis, and stroke-like episodes (nucleotides 3243 and 3271). EEG recorded during an attack showed no paroxysmal discharges and no laterality in the parietal region. A ¹²³I-IMP SPECT study was performed while the patient was having frequent paroxysmal attacks and showed marked hypoperfusion in the left parietal lobe (figure 3, C and F) when compared with the images obtained during the previous admission (figure 3, B and E). Dysarthria and right-limb ataxia remained at the time of first

From the Department of Neurology (Drs. Matsui, Sano, Tomimoto, and Shibasaki) and Human Brain Research Center (Drs. Hashikawa, Fukuyama, and Shibasaki), Kyoto University Graduate School of Medicine, Japan.

Present address: H. Shibasaki, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD.

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Address correspondence and reprint requests to Dr. Masaru Matsui, Department of Neurology, Kyoto University Graduate School of Medicine, 54 Shogoin-Kawaharacho, Sakyo-ku, Kyoto 606-8507, Japan; e-mail: matsuum@kuhp.kyoto-u.ac.jp

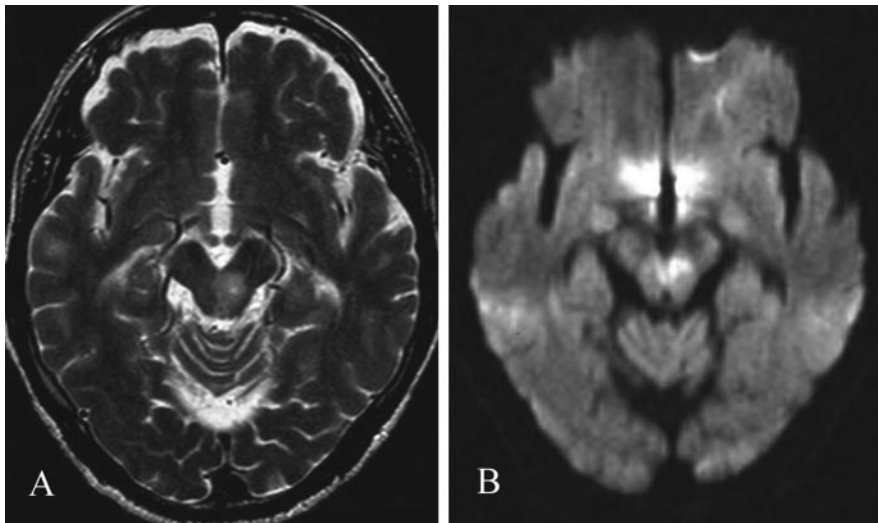


Figure 1. Axial T2-weighted (repetition time/echo time = 4860/10; A) and diffusion images (B) obtained by 1.5-T MRI 5 days after the onset of the initial symptoms. A high intensity lesion is seen in the left midbrain on T2-weighted (A) and diffusion images (B). This lesion involved the left red nucleus and left superior cerebellar peduncle, but the cerebral peduncle was spared.

SPECT scan; however, these symptoms had markedly improved since onset. After treatment with phenytoin, hypoperfusion in the left parietal lobe improved (figure 3, D and G).

Discussion. Our patient had paroxysmal dysarthria and ataxia 6 weeks after the onset of midbrain infarction, which was documented by clinical symptoms, cranial MRI, and other laboratory findings.

Paroxysmal dysarthria and ataxia are characteristic of MS,¹⁻³ and few cases have been reported in other conditions.⁴ In previous reports, paroxysmal attacks were suppressed by the administration of carbamazepine.^{3,5} In our patient, phenytoin and carbamazepine were effective.

An important question is how midbrain infarction causes paroxysmal dysarthria and ataxia. Transversely spreading, ephaptic activation of the demyelinated axons may cause paroxysmal symptoms in MS.² An irritable lesion affecting a fiber tract involved in the central motor control, such as the brachium conjunctivum, can produce ataxia.² Ataxia can be caused by hyperactivity and hypoactivity in a pathway subserving motor control. Therefore, ataxia can be produced by the bombardment of central structures with excessive impulses along proprioceptive paths.² In this patient, MRI showed a midbrain lesion involving the crossed fibers in the cerebellothalamocortical pathway.

During the period of frequent paroxysmal attacks, SPECT imaging showed marked hypoperfusion in the left parietal lobe, which improved after phenytoin treatment. Why was transient hypoperfusion seen in the left parietal lobe during the period of frequent paroxysmal attacks? The interconnection between the cerebral cortex and the cerebellum consists of the cerebellothalamocortical projection and the corticopontocerebellar loop. The parietal lobe is one of the regions in which the interconnection is densely developed with the cerebellum. For example, patients with ataxic hemiparesis show hypoperfusion of the inferior parietal lobe on SPECT.⁶ An ataxic hemiparesis syndrome may result from functional depression (diaschisis) consequent to the interruption at many levels of the cerebello-corticocerebellar closed loop.⁶

In our case, right-limb ataxia improved completely 4 weeks after onset, whereas paroxysmal dysarthria and ataxia appeared subsequently. A previous experimental study showed that behavioral recovery occurred in association with enhanced neural sprouting and synaptogenesis in focal cerebral ischemia in rats.⁷ This may indicate that the neural sprouting and

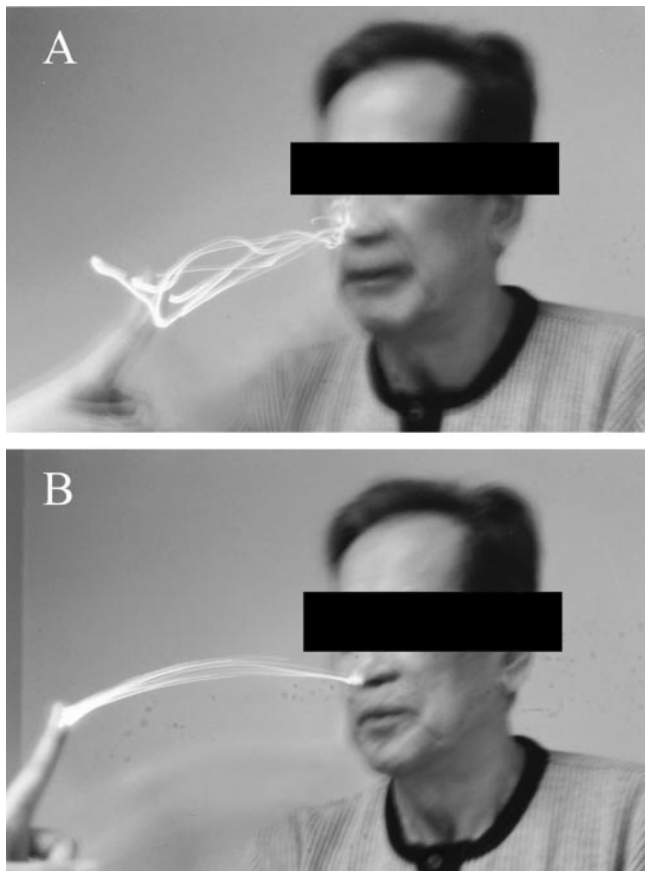


Figure 2. Both (A) and (B) show a picture of the patient performing the nose-finger test. A penlight was attached to the tip of the right second finger during a paroxysmal attack (A) and between attacks (B).

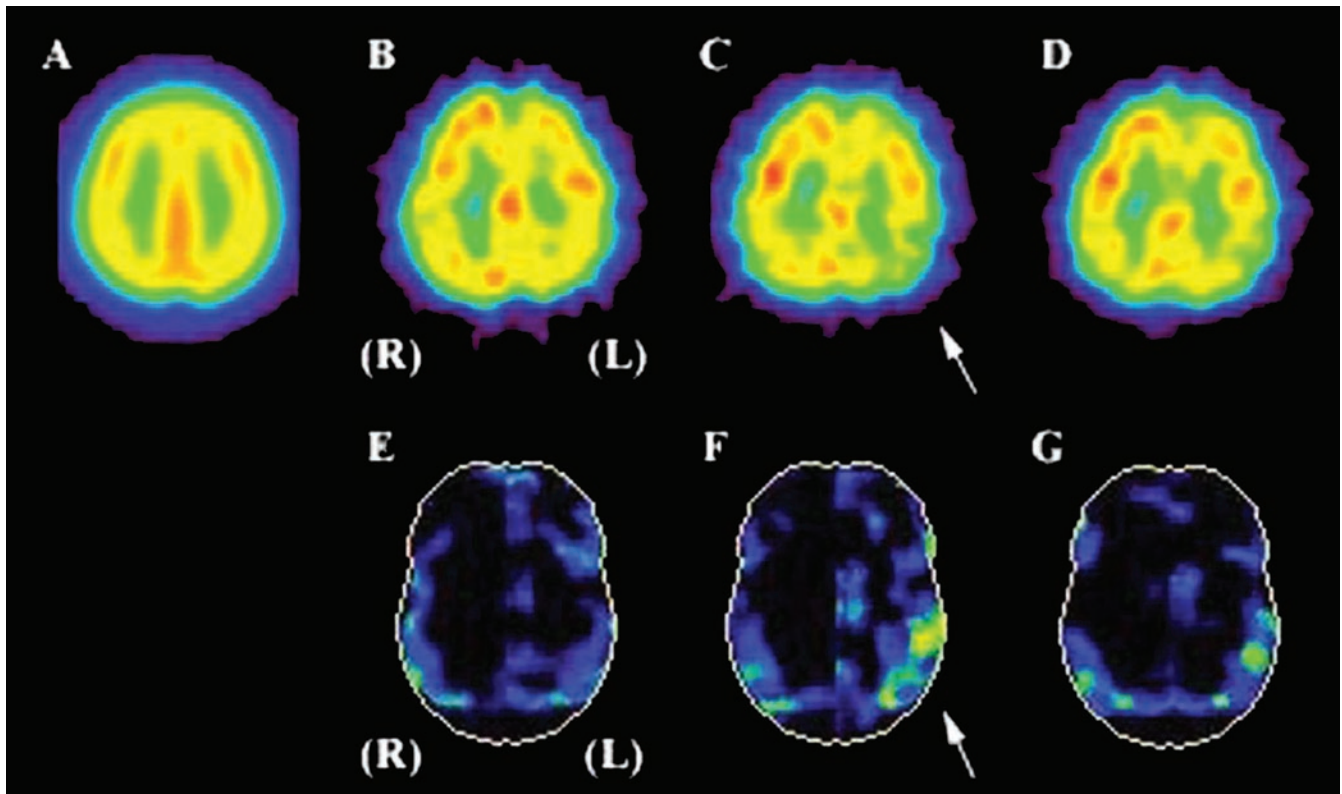


Figure 3. Regional cerebral blood flow (rCBF) is shown on standard transaxial images using ^{123}I -IMP SPECT (A to D) and Z score images using the three-dimensional stereotactic surface projections (superior view, E to G). A higher pixel intensity represents a greater reduction in perfusion (E to G). By averaging extracted database sets of the control group, a contrast database was created. (A) Shows the averaged SPECT image from the control group. No apparent hypoperfusion in the parietal lobe was seen during the first set of scans after the stroke (B, E). When compared with rCBF obtained 10 days after the onset of the initial symptom (B, E), marked hypoperfusion of the left parietal lobe was seen 1 week after the onset of the paroxysmal attacks (arrows; C, F). Hypoperfusion improved after treatment with phenytoin (D, G).

consequent ephaptic transmission are possible mechanisms responsible for this symptom. Ephaptic transmission at the midbrain level may interrupt the cerebellothalamocortical pathway, which is known to be excitatory and tonically active, and thus may induce cerebral hypoperfusion in the parietal lobe.^{8,9} This possibility is directly supported by the effectiveness of phenytoin, which is known to reduce axonal excitability by limiting the membrane permeability to calcium. Alternatively, retrograde or trans-synaptic degeneration in the cerebellothalamocortical pathway may cause cerebral hypoperfusion in the parietal lobe. However, this possibility is unlikely because cerebral hypoperfusion improved after treatment with phenytoin, and there were no MR abnormalities found in the parietal lobe.

We propose that motor control system dysfunction involving the cerebellothalamocortical pathway may induce parietal diaschisis and paroxysmal dysarthria and ataxia simultaneously.

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