

Hyperglycemia-induced Hemichoreoathetosis: The Presenting Manifestation of a Vascular Malformation of the Lenticular Nucleus

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A 72-year-old diabetic woman developed paroxysmal hemichoreoathetosis during an episode of nonketotic hyperglycemia. The movement disorder abated as the blood glucose normalized. A computed tomographic scan revealed a vascular malformation involving the lenticular nucleus on the side contralateral to the dyskinesia. Hyperglycemia has rarely been reported to cause episodic dyskinesias, but there have been no prior reports of patients with striatal vascular abnormalities in whom hyperglycemia seemingly caused a transient movement disorder. (*Neurosurgery* 18:787-790, 1986)

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Nonketotic hyperglycemia has rarely been reported to cause transient dyskinesias (2, 18). Likewise, arteriovenous malformations (AVM) of the basal ganglia are uncommon and have infrequently been implicated as a cause of movement disorders (3, 7, 12, 15, 16, 19). We report the case of a diabetic woman who developed sudden left-sided choreoathetosis associated with nonketotic hyperglycemia. The dyskinesias ceased as she became normoglycemic, and computed tomographic (CT) scanning and cerebral angiography revealed a vascular malformation of the right lenticular nucleus.

CASE REPORT

A 72-year-old woman with an 8-year history of insulin-requiring diabetes mellitus suddenly developed abnormal movements of the left arm in November 1981. These movements increased over the ensuing 3 hours and involved the left leg and face in addition to the arm. She sought medical attention when the movements did not spontaneously cease. She denied any prior history of abnormal movements, and there was no family history of movement disorders. She was receiving no medications other than the insulin and had never used psychotropic medications. She denied visual complaints, memory dysfunction, weakness, or sensory loss. She specifically denied a prior history of rheumatic chorea or chorea gravidarum.

Her general medical examination, including vital signs, was normal. She was alert and oriented with normal mentation. Speech was clear, with intact comprehension and repetition. Cranial nerve examination was normal. Choreic movements of the left arm and leg, and to a lesser degree the face, were associated with intermittent distal athetotic movements, and at times the left arm was held in a dystonic posture. Voluntary movement did not increase or diminish the dyskinesias. There were no abnormal movements on the right. Muscle tone was normal, and there was no obvious weakness. Deep tendon reflexes were 1 on the right and 1+ on the left, and there was no Babinski response. Primary and cortical sensory modalities were normal. The carotid arteries were without bruits. The blood glucose level was 501 mg/dl, and ketones were absent. The sodium value was 138, the potassium value was 4.0, and the blood urea nitrogen was 20 mg/dl. Liver function tests,

complete blood count, antinuclear antibody test, VDRL, calcium and phosphorous levels, and a sedimentation rate were all normal. The calculated serum osmolarity was 329 milliosmoles/litre. The patient was treated with insulin and fluids, and 8 hours later the movements had ceased. Examination at this time was normal except for slight dystonic posturing of the left arm when walking; blood glucose level was 125 mg/dl at this time. CT scan revealed an enhancing lesion of the right lenticular nucleus (Fig. 1); no other abnormalities were present. Cerebral arteriography revealed that the right carotid artery was normal without evidence of atherosclerosis. A faint blush was evident in the area of the lateral globus pallidus-putamen complex on the right (Fig. 2); the intramedullary vein lateral and superior to the blush was prominent and joined the thalamostriate vein. Arteriovenous shunting was present with early filling of the thalamostriate vein and internal cerebral vein on the right. The lenticulo-striate arteries were prominent and supplied the vascular malformation, which appeared to be predominantly of venous origin. The patient was discharged from the hospital after 4 days of confinement because the dyskinesias did not reappear. The patient has remained neurologically asymptomatic for 4 years. Her diabetes has remained under good control, and the blood sugar level has remained below 250 mg/dl. A CT scan with contrast in July 1985 was unchanged from the one performed in November 1981; it demonstrated persistence of the enhancement (Fig. 3).

DISCUSSION

Neurological abnormalities are common in nonketotic hyperglycemia and may include delirium or coma, in addition to more focal neurological changes (10, 20). The focal signs include aphasia, hemiparesis, hemisensory deficits, tonic ocular deviation, and focal or generalized seizures (10, 20). Continuous focal epilepsy (epilepsia partialis continua) is known to complicate nonketotic hyperglycemia. These seizures may occur when the limb is at rest or, more rarely, may be movement-induced. The typical movement-induced seizure is tonic and triggered by movement of the involved limb; electroencephalographic (EEG) manifestations of the seizures are often absent (1, 20). Less commonly, the movement-

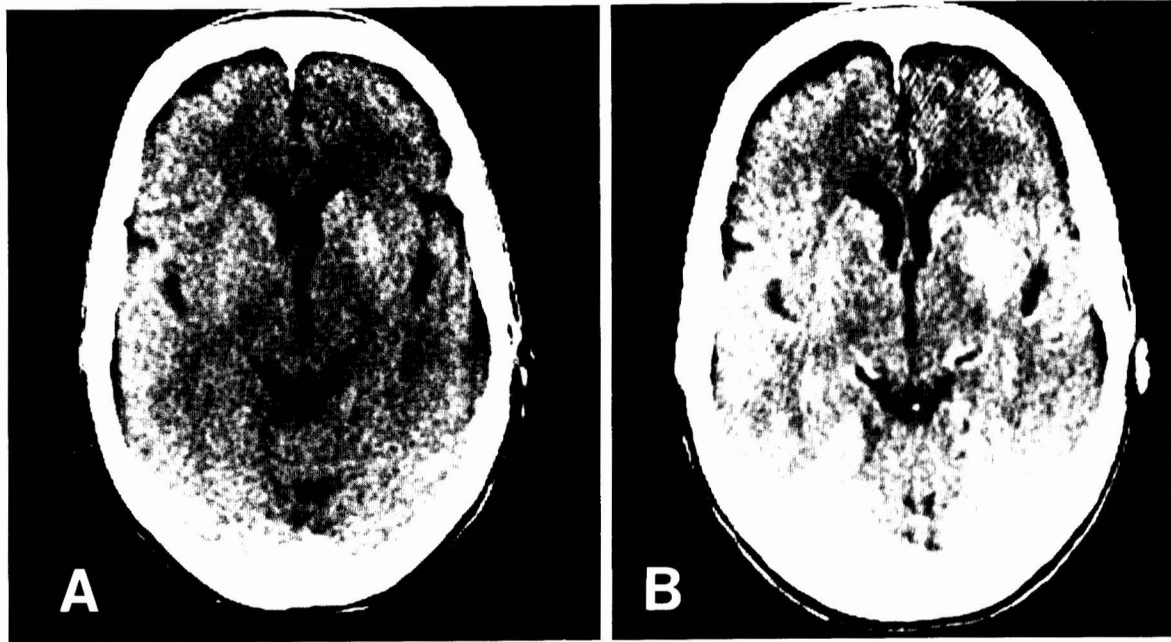


FIG. 1. CT (November 1981) reveals an ill-defined density in the right lenticular nucleus on the unenhanced scan (A) that enhances after the administration of contrast agent (B). The patient's right side is to the viewer's right.

induced seizure is of the tonic-clonic type occurring after sustained repetitive movement of the limb; focal EEG abnormalities are commonly observed (1). In contrast to the nonketotic hyperglycemic states, neurological abnormalities other than depression of the level of consciousness are uncommon in diabetic ketoacidosis (10).

There have been only two reports dealing with hyperglycemia-induced dyskinesias (2, 18). In 1960, Bedwell (2) reported a hypertensive patient who at age 60 developed "continuous facial grimacing and wild involuntary movements of the face, neck, and extremities" on the right, associated with a blood sugar of 450 mg/100 ml. The movements gradually diminished over a 4-week period as the blood sugar level normalized; on discharge from the hospital, minimal choreoathetotic movements persisted. Over the ensuing 1½ years, this patient had at least two exacerbations of the movement disorder, each associated with hyperglycemia. At the time of her last evaluation, she had a mild left hemiparesis, bilateral choreoathetotic movements of the hands, and bilateral "facial grimaces." Lacking pathological confirmation, one can only speculate on the etiology of this patient's movement disorder. It is quite likely that the persistent dyskinesias were the result of infarction of subcortical structures. This patient did not have reversible hyperglycemia-induced dyskinesias; however, her case illustrates how hyperglycemia may exacerbate a persistent movement disorder. Goldblatt et al. (9) reported a patient in whom two distinct episodes of severe left-sided hemichorea were associated with two separate right-sided cerebral lesions, one in the putamen and the second in the caudate nucleus, as confirmed at necropsy. This patient was hyperglycemic through part of her hospital stay, but the authors state that they could not correlate her dyskinesias with a rise in the blood glucose level. Episodic dyskinesias have also been reported as a manifestation of cerebral ischemia (13), with the movements lasting from minutes to an hour. Kase et al. (11) recently reported a hypertensive patient

with acute hemichorea-hemiballismus associated with a lacunar infarct documented by CT in the contralateral putamen and caudate nuclei.

Rector and associates (18) reported three patients with nonketotic hyperglycemia and transient hemichorea with normal CT scans of the head. Their blood sugar levels ranged from 456 to 1000 mg/dl; serum osmolarity ranged from 303 to 331 milliosmoles/litre. The dyskinesias were focal in all three patients and lasted from 18 to 24 hours; as the blood glucose normalized, the movements ceased. These patients are clearly different from the one reported by Bedwell (2) because their dyskinesias were truly transient. Thus, dyskinesias secondary to hyperglycemia last hours and not days or weeks and are not persistent following the correction of the hyperglycemia, unless there is underlying central nervous system pathology.

Vascular malformations in the region of the basal ganglia are uncommon. In the series of 110 AVMs reported by Paterson and McKissock (16), only 8% were located in the basal ganglia, and 5.7% of the series of AVMs from the Lahey Clinic were in this area (15). Extrapyrmidal dysfunction secondary to an AVM is quite rare, with only eight cases having been reported (Table 1). The precise pathophysiological mechanisms involved in the production of extrapyramidal movements from AVMs are not known, but the postulated mechanisms are shunting of blood through the AVM with a vascular steal occurring from the normal brain tissue, mass effect upon the basal ganglia by the AVM itself or by a hematoma, or abnormalities of neural tissue development associated with the abnormal blood vessel development (7).

Chorea and athetosis are movements that may arise from dysfunction within the basal ganglia. Carpenter (4) reviewed the reports of 32 patients with hemiathetosis; 22 had lesions involving the lenticular nucleus. Huntington's disease is associated with chorea and caudate atrophy and depletion of gamma aminobutyric acid (GABA) has been found in the

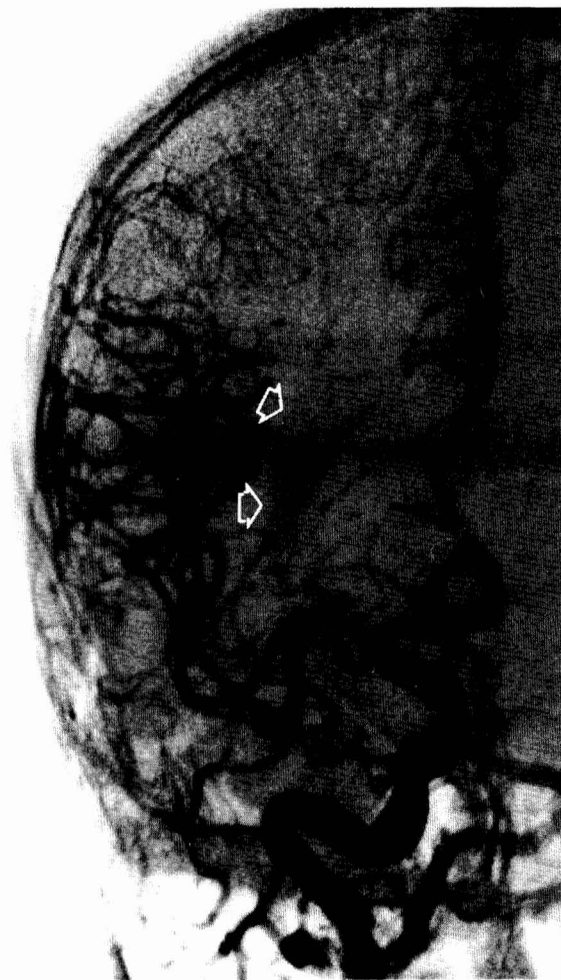


FIG. 2. Anteroposterior view of the intracranial branches of the right internal carotid artery reveals a lens-shaped vascular malformation (arrows) in the area of the lateral globus pallidus and the putamen.

brains of patients with this disorder, implicating GABA deficiency as a possible cause of the choreic movements (17). There is a significant relationship between the subthalamic nucleus, globus pallidus, and substantia nigra (3). The subthalamic nucleus has inhibitory influences on the globus pallidus mediated by GABA and dopamine-containing projections (3, 6). GABA is found in highest concentration in the globus pallidus, substantia nigra, and hypothalamus, with an intermediate concentration occurring in the caudate and putamen (5). That GABA is involved in the production of dyskinesias has been demonstrated in the monkey by the studies of Crossman et al. (6), who were attempting to identify the site of action of GABA antagonists in the production of experimental hemiballismus. Stereotactic injection of the GABA antagonist picrotoxin near the lateral segment of the globus pallidus gave rise to a hyperkinetic disorder of both contralateral limbs. These movements resembled the dyskinesias elicited by similar injections into the subthalamic nucleus (hemichorea that resembled hemiballismus); however, a marked difference was the production of a prominent athetoid component to the movement in the upper extremities. The injection of picrotoxin into the dorsomedial putamen induced myoclonic movements of the neck musculature and the con-



FIG. 3. CT with contrast (July 1985) demonstrates the enhancing area in the right lenticular nucleus, which is unchanged from the previous scan of November 1981. The patient's right side is to the viewer's right.

tralateral upper limb. The injection of the GABA agonist muscimol was without effect at the sites where GABA antagonists induced dyskinesias. Thus it would seem that localized deficiencies of GABA in the basal ganglia or related nuclei are in part responsible for the appearance of dyskinesias.

Nonketotic hyperglycemia and ketoacidosis may cause a depression of the Krebs' cycle (10, 20). In these conditions, the energy requirements of brain tissue will be met by increased metabolism of ketone bodies during ketoacidosis or amino acids (e.g., GABA or L-glutamic acid) (10, 20). GABA may be metabolized in the brain via the GABA shunt, which represents an alternate pathway to a portion of the Krebs' cycle (3). The GABA shunt may provide 10 to 40% of the energy requirement of neural tissue, and the increased rate of utilization of GABA in the presence of a reduced rate of activity of the Krebs' cycle may result in a deficiency of GABA that could cause abnormal movements in addition to seizures (10, 20). Overall, the net result in nonketotic hyperglycemia is a lowering of the GABA level, reducing the threshold for seizures and increasing the likelihood of dyskinesias. Hyperglycemia also produces a global decrease in regional cerebral blood flow (CBF) with maximal reduction in the globus pallidus, and it enhances the development of brain injury by ischemia (8, 14). Thus, in the presence of hyperglycemia, the reduction of CBF, possibly more so in the pallidum, may contribute to focal ischemia and reduction of local amounts of GABA.

Choreoathetosis or hemiballismus may be the initial signs of nonketotic hyperglycemia, and they should be expected to disappear as the blood glucose level is brought to normal levels. It is possible that underlying focal cerebrovascular disease provides the base for the metabolic changes that may result in depletion of neurotransmitters, particularly GABA. A serum glucose level should be determined in any patient with the new onset of ballism or choreoathetosis, and a CT scan should be performed to exclude vascular disease of the basal ganglia.

TABLE 1
Extrapyramidal Dysfunction Due to Cerebrovascular Malformations^a

Author (Ref.)/Year	Age*	Type of Movement	SAH	Type and Site of Malformation	Treatment	Follow-up
Paterson & McKissock (16)/1956	NR	Athetosis of hemiparetic limbs	NR	AVM "central"	NR	NR
Shaw (19)/1972	19	L spasmodic torticollis	+	AVM fed by hypertrophied R MCA	NR	NR
Lobo-Antunes et al. (12)/1974						
Case 1	1	R arm tremor & dystonia	+	AVM L thalamus, BG	Radiation	Movements ceased after first SAH
Case 2	NR	L torticollis	+	AVM R posterior thalamus	NR	9 yr after SAH without symptoms/signs
Case 3	19	Retrocollis	-	AVM R parietal lobe	Section of C-3-C-5 nerve roots	Slight improvement
Case 4	9	L arm tremor	-	AVM R thalamus, BG	Embolization ×2	No improvement
Diamond et al. (7)/1982						
Case 1	39	L arm tremor	-	AVM R temporal lobe, BG	Haloperidol	No improvement
Case 2	59	L choreoathetosis	-	Refused angiogram; CT showed enhancement of R BG	Haloperidol	No improvement
Burke et al. (3)/1984	48	L choreoballismus	-	Venous angioma head of R caudate	Halperidol & clonazepam	Major benefit from both drugs
Vincent/1986 (present report)	70	L choreoathetosis & dystonia	-	AVM R lateral globus pallidus & putamen	Associated with hyperglycemia; movements ceased when glucose normal	No recurrence in 3.5 yr

^a Abbreviations: * at onset of symptoms; NR, not reported; SAH, subarachnoid hemorrhage; BG, basal ganglia; MCA, middle cerebral artery; R, right; L, left.

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