Hemiballismus/hemichorea constitute a neurological syndrome characterized by violent proximal involuntary movements on one side of the body, involving mainly the upper extremity. They are usually associated with small infarcts or hemorrhages in the vicinity of the subthalamic nucleus. Tumors, granulomas and surgical lesions were also reported as causative pathologies. Lesions in different sites of the striatum e.g. the subthalamic fasciculus and the head of the caudate nucleus were reported to cause hemiballismus as well.

In the last two decades, several patients suffering from hemichorea or hemiballismus, associated with hyperglycemia and diabetes, were reported. In this paper we describe three other cases, review the literature on the subject and propose a possible pathophysiological explanation for this phenomenon.
**Case Reports**

**Patient 1:** A 71-year-old woman was admitted to the internal medicine department because of choreiform movements in her left limbs, which had developed gradually on the day of her admission. Her medical history was unremarkable and there was no family history of chorea. Besides the movement disorder, the neurological examination yielded normal findings. Laboratory tests showed a blood sugar level of 560 mg/dl. A CT scan of the brain was normal. The hemichorea resolved 24 hours after the correction of the hyperglycemia. No residual neurological deficit was found.

**Patient 2:** A 78-year-old woman, with no family history of chorea, presented with left hemichorea, which had started two days earlier. The patient was known to suffer from hypertension. Repeated blood sugar level evaluations in the previous years were normal. A brain CT scan was normal and laboratory tests revealed an elevated blood sugar level (490 mg/dl). Correction of the hyperglycemia resulted in disappearance of the movement disorder within 24 hours. The neurological examination was normal on discharge. On a three-year follow-up, no abnormal movements were noted and no signs of cerebrovascular disease were found.

**Patient 3:** An otherwise healthy 54-year-old woman was admitted to the neurology department because of right hemiballismus, which appeared a week prior to her admission. There was no family history of chorea. Blood sugar levels were 460 mg/dl on admission. A CT scan of the brain demonstrated a discrete hyperdense lesion in her left basal ganglia without mass effect or contrast enhancement. A high intensity lesion was observed on a T1-weighted MRI in the same area (Figure 1). Haloperidol 1 mg was instituted in parallel with hypoglycemic therapy. Three days later, the blood sugar level was normal, the symptoms resolved and haloperidol was discontinued. The results of neurological examination were normal on discharge. Hemiballismus did not recur after cessation of haloperidol. On a two-year follow-up, the movement disorder was not observed and no strokes or transient ischemic attacks were documented.

**DISCUSSION**

Unilateral proximal involuntary movements (hemichorea or hemiballismus) are frequently associated with subthalamic nucleus lesions. The subthalamic nucleus is a lens-shaped group of cells ventral to the thalamus. Its neurons utilize the excitatory neurotransmitter glutamate. They serve as the main excitatory input to the medial part of the globus pallidus, which inhibits (by

![Figure 1: A T1-weighted MRI of patient 3 demonstrating a hyperintense lesion in the basal ganglia.](image1)

![Figure 2a: The normal indirect pathway of the cortico–basal ganglia–thalamic circuit.](image2a)

![Figure 2b: A lesion in the subthalamic nucleus disrupts the excitation of the medial part of the globus pallidus, thereby decreasing its inhibitory influence on the ventrolateral and ventroanterior thalamus.](image2b)
using gamma amino butyric acid – GABA) the activity of the ventrolateral thalamus. Destruction of the subthalamic nucleus causes a decrease of this inhibitory function and increases thalamic excitation of the motor and premotor cortex, resulting in involuntary movements (Figure 2).

Our patients suffered from hemichorea that was associated with new onset hyperglycemia. The hemichorea resolved shortly after correction of the hyperglycemia, suggesting that the pathophysiology of this movement disorder is related to the metabolic change. Patient 3 was treated with haloperidol, but the quick recovery and lack of recurrence of the hemichorea after cessation of the drug suggests a similar association.

Thirteen cases of hyperglycemia-associated hemichorea/hemiballismus have been reported previously (Table). The syndrome has been fairly uniform. Most patients are female (F/M ratio of 11/2), ranging in age from 50 to 80 years. They usually have no history of diabetes mellitus (9/13). They develop choreic or ballistic movements on one side of the body over a period of hours. Serum glucose levels are elevated, in the range of 400-1000 mg/dl. In most patients, a lowering of the serum glucose is sufficient to reverse the movement disorder within 24-48 hours (even when the hemichorea lasts for weeks before the treatment). CT scans are normal (8/13) or reveal a hyperdense lesion in the basal ganglia, without mass effect. MRI scans of the brain may show hyperintense caudate or putaminal lesions on T1-weighted images without T2 alterations (3/3). The clinical picture in our patients was similar to that described by other authors. This clinical syndrome may be different, however, from the hemichorea reported in patients with known diabetes. A recent report by Lee et al described eight women with diabetes who developed hemichorea. In those patients and in other case reports the movement disorder was not directly associated with the presence of hyperglycemia and continued, despite normal glucose levels, for days or weeks.

The pathophysiology of hyperglycemia-associated hemichorea/hemiballismus has not been settled. The acute onset of the hemichorea/hemiballismus suggests a vascular lesion. The hyperintense T1-weighted lesions, demonstrated in the three patients studied with MRI, are compatible with a focal hemorrhage or hemorrhagic infarct in the striatum. The rapid disappearance of the movement disorder after correction of the hyperglycemia suggests a direct metabolic influence. In nonketotic hyperglycemia, nerve cells can utilize gamma-aminobutyric acid (GABA) as an alternative energy source. Depletion of GABA may cause a decrease in GABAergic activity, thereby decreasing the inhibition of the thalamus by the medial part of the globus pallidus. We believe that the combination of decreased thalamic inhibition and a recent or old

<table>
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<tr>
<th>Table: Reported cases of hyperglycemia-associated hemichorea</th>
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<tbody>
<tr>
<td><strong>No. of patients</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Bedwell12 1960</td>
</tr>
<tr>
<td>Rector2 1982</td>
</tr>
<tr>
<td>Sanfield3 1986</td>
</tr>
<tr>
<td>Lin4 1994</td>
</tr>
<tr>
<td>Takamatsu5 1995</td>
</tr>
<tr>
<td>Our series</td>
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<td><strong>Total</strong></td>
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* Blood glucose levels on admission in mg/dl.
** h – hours, d – days, w – weeks.
striatal lesion (which may increase the inhibition of the subthalamic nucleus) may be responsible for the appearance of this unilateral hyperkinetic movement disorder. The female predisposition may be related to postmenopausal alterations of GABA or dopamine receptors. Further study is needed to validate our hypothesis and to explain why female patients are almost exclusively affected.

Undiagnosed diabetes mellitus should always be suspected in patients who develop hemiballistic or hemichoreic movements. If the serum glucose is high, symptomatic therapy with dopamine receptor antagonists may not be required, as the movement disorder usually responds rapidly to correction of hyperglycemia.

References