

# Recurrent Hypoglycemia-induced Hemiballism with Self-limited after Sleep – A Case Report

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## Abstract

**Purpose:** Hemiballism caused by hypoglycemia is rare. We presented a case who suffered from episodic hemiballism induced by hypoglycemia with spontaneously recovery after sleep. The possible mechanism of these self-limited episodes was also discussed.

**Case report:** An 82-year-old female diabetic patient took oral anti-diabetic drugs (OADs) regularly. The doctor changed OADs doses and her appetite became poor before admission. She suffered from episodic left side involuntary movements with consciousness disturbance, and recovered spontaneously after a six-to-eight hour sleep in every attack at home. Very low finger sugar (20 mg/dl) was noted while attack at admission. Brain computed tomography (CT), magnetic resonance imaging (MRI) and electroencephalography (EEG) were non-remarkable. Brain technetium-99m-labeled ethyl cysteinate dimer single-photon emission computed tomography (Tc-99m-ECD SPECT) showed relative hyperperfusion over right side basal ganglion and thalamus. No further involuntary movement was observed after better sugar control.

**Conclusion:** We suppose that sleep modify the glucose counterregulatory responses with increased growth hormone, which salvage hypoglycemic status in our presented case. With this report, we would like to draw clinicians' attention to including the treatable hypoglycemia state in the differential diagnosis of episodic involuntary movements.

**Keywords:** Hypoglycemia, Hemiballism, Glucose regulation.

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## INTRODUCTION

Hemichorea–hemiballism linked to non-ketotic hyperosmolar hyperglycemia state (NKHS) is well-documented among diabetic patients. However, few case

reports have reported induction via hypoglycemia. Here we present an 82-year-old woman with diabetes mellitus who suffered from episodic left hemiballism and consciousness disturbance related to recurrent hypoglycemia.

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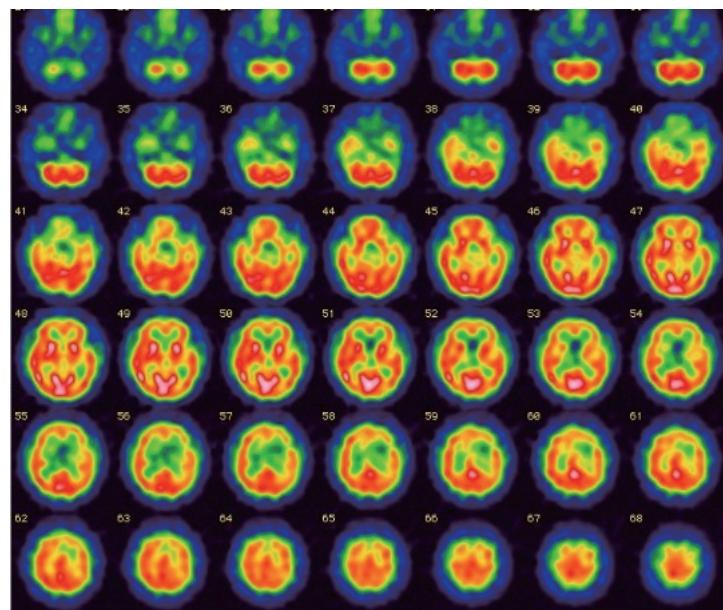
## CASE REPORT

An 82-year-old woman with type 2 diabetes mellitus, hypertension and hyperlipidemia, was followed up in the outpatient department regularly. HbA1C level was checked as 8.3% three months previous to admission, so the doctor adjusted her oral anti-diabetic drug (OADs) intake then. Her appetite became worse but she took OADs as usual within one month before admission. She presented to our hospital for episodic left side limbs violent involuntary movements and consciousness disturbance. The episodes had occurred almost every day since one week before admission. Most episodes were recorded at noon, about one hour after she took OADs. The involuntary movements ceased spontaneously and consciousness was fully recovered after a six-to-eight hour sleep without any food intake. She hurt herself during these events sometimes. No similar symptoms had been observed before.

At admission, the neurological examination during involuntary movement attack revealed confusion in consciousness with Glasgow Coma Scale (GCS) E4V4M5, along with irregularly high-amplitude violent, non-patterned involuntary movements in her left side

limbs, which was supposed to be left hemiballism. Finger sugar was checked as only 20 mg/dl at that time. After 60ml Dextrose 50% was given intravenously, the left hemiballism and consciousness disturbance rapidly and totally recovered and the finger sugar was measured as 293 mg/dl.

No neurological deficit after her consciousness returned to normal was found. Results of routine laboratory tests, including hemogram, biochemistry and lipid profiles were normal. The other lab data were HbA1C level 6.7%, Na 128 mmol/l, K 2.7 mmol/l, ionized Ca 4.5 mg/dl, TSH 1.73 µIU/ml, free T4 0.91 ng/ml, and cortisol 16.42 µg/dl. There was no significant abnormal finding of brain computed tomography (CT) on admission day except for cerebral cortical atrophy. The brain magnetic resonance imaging (MRI) did not show compatible focal structural lesions and electroencephalography (EEG) did not show epileptiform discharge. Brain technetium-99m-labeled ethyl cysteinate dimer single-photon emission computed tomography (Tc-99m-ECD SPECT), arranged eight days after the last attack, showed relative hyperperfusion over right side thalamus and basal ganglia, compared with diffuse cortical hypoperfusion (Fig. 1). No further involuntary movement or consciousness disturbance



**Fig.1.** Brain technetium-99m-labeled ethyl cysteinate dimer single-photon emission computed tomography (Tc-99m-ECD SPECT) eight days later showed relative hyperperfusion over right side thalamus and basal ganglion, with background of diffuse cortical hypoperfusion. It may suggest the recovery from hypoglycemia related hemiballism based on the diffuse cortical degenerative parenchymal disorder.

was observed after we adjusted her OADs to maintain euglycemia during the admission period.

## DISCUSSION

Non-ketotic hyperosmolar hyperglycemia state (NKHS)-induced hemichorea–hemiballism is well-documented. However, hypoglycemia related to hemichorea–hemiballism has rarely been reported. To the best of our knowledge, this is the first case report of episodic hemiballism induced by recurrent hypoglycemia with spontaneous recovery after sleep.

Brain image study is not sensitive for diagnosis of hypoglycemia-related involuntary movement. Some of the abnormal findings in brain MRI might show basal ganglia hyperintense lesions in T2-weighted imaging or diffusion-weighted imaging (DWI). Normally or rarely, hypointense lesions in unilateral or bilateral basal ganglia in T1-weighted imaging can be noted, and the post-contrast enhancement might occur sometimes<sup>(1,2,3)</sup>. Why hypoglycemia, a systemic disorder, can result in unilateral involuntary movements is still unknown.

One possible mechanism for the involuntary movements related to hypoglycemia is that when hypoglycemia attacks acutely, the brain uses its glycogen stores and other endogenous substrates, such as glutamate. Then, aspartate level probably rises because the equilibrium of the aspartate aminotransferase reaction favors aspartate production<sup>(1,4)</sup>. The aspartate, a known neurotoxin by virtue of its excitatory properties, especially to the cerebral cortex, caudoputamen and hippocampus, induces involuntary movements<sup>(1,5)</sup>.

Similar SPECT finding to our presented case was demonstrated in one paroxysmal kinesigenic choreoathetosis report. This case report showed a 14-year-old boy with hyperperfusion of contralateral basal ganglia on his ictal brain SPECT, while the other investigations, including EEG and MRI of the brain, showed normal results<sup>(6)</sup>. Another report demonstrated abnormal SPECT scan in two chorea patients associated with severe hypoglycemia. The brain SPECT scan showed hyperperfusion over basal ganglion after chorea episodes<sup>(3)</sup>. In our case, the brain SPECT showed relative hyperperfusion of right thalamus and basal ganglion eight days after involuntary movements attacked, compared

with background of diffuse cortical hypoperfusion. It is probable that the blood glucose changes may induce a compensatory mechanism, which is the explanation for hyperperfusion of basal ganglion<sup>(7)</sup>.

In healthy humans, blood glucose is regulated by endogenous glucagon and insulin, so return to baseline might occur within several hours if hypoglycemia happens. The defective glucose counterregulatory mechanism is composed of the following steps<sup>(8,9)</sup>. The first defense is to decrease insulin secretion from pancreatic beta-cells when the plasma glucose reaches the threshold of 80-85 mg/dl, which can increase glucose production and decrease glucose utilization by tissues other than the brain. Second, when the plasma sugar falls below the normal range as 65-70 mg/dl, the glucagon from pancreatic alpha-cells and adrenomedullary hormones act. Third, epinephrine works. Lower levels (50-55 mg/dl) cause neurogenic and neuroglycopenic hypoglycemic symptoms, which push us to eat. However, these protective mechanisms are impaired variably, especially in type 1 and advanced type 2 diabetic patients.

Interestingly, in this presented case, episodic hypoglycemia-induced involuntary movement and consciousness disturbance could totally recover spontaneously after several hours of sleep. This might be explained by sleep modulating glucose regulation; indeed, sleep onset resulted in elevation of plasma glucose and insulin. There is some evidence that the absolute rise in glucose levels is associated with a large pulse of growth hormone secretion during sleep<sup>(10)</sup>. Further evidence has shown growth hormone causes decreases in both hepatic and extrahepatic effects of insulin, and then inhibits glucose utilization and augments glucose production during sleep<sup>(11,12)</sup>. In our presented patient, we did not have the chance to check growth hormone for our patient because she did not suffer from episodic left hemiballism after admission. We suggest that, when hypoglycemia occurred, the growth hormone modulated glucose regulation during her sleep, and eventually, normalized the serum glucose spontaneously.

## CONCLUSION

We present a case that had episodic left hemiballism induced by recurrent hypoglycemia with self-limited

recovery after sleep. With this report, we wish to draw clinicians' attention to the importance of including treatable hypoglycemia state in the differential diagnosis of this rare neurologic presentation and clinical course.

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## REFERENCE

1. Schmidt P, Böttcher J, Ragoschke-Schumm A, Mentzel HJ, Wolf G, Müller UA, Kaiser WA, Mayer TE, Saemann A. Diffusion-Weighted Imaging of Hyperacute Cerebral Hypoglycemia. *Am J Neuroradiol.* 2011 Aug;32(7):1321-7.
2. Lee D, Lee D, Ahn TB, Hong IK, Kim DY. Recurrent hemichorea after a hypoglycemic episode. *Parkinsonism Relat Disord.* 2014;20(6):676-7.
3. Lai SL, Tseng YL, Hsu MC, Chen SS. Magnetic Resonance Imaging and Single-Photon Emission Computed Tomography Changes in Hypoglycemia-Induced Chorea. *Mov Disord.* 2004;19(4):475-8.
4. Gorell JM, Dolkhart PH, Ferrcnelli JA. Regional levels of glucose, amino acids, high energy phosphates, and cyclic nucleotides in the central nervous system during hypoglycemic stupor and behavioral recovery. *J Neurochem.* 1976 Nov;27(5):1043-9.
5. Auer RN, Wieloch T, Olsson Y, Siesjö BK. The distribution of hypoglycemic brain damage. *Acta Neuropathol.* 1984;64(3):177-91.
6. Ko CH, Kong CK, Ngai WT, Ma KM. Ictal (99m) Tc ECD SPECT in paroxysmal kinesigenic choreoathetosis. *Pediatr Neurol.* 2001;24:225-227.
7. Lee D, Kwon YN, Shon SH, Lee JH, Ahn TB. Glycemic and vascular choreoballism as main causes of secondary choreoballism involving the putamen. *Parkinsonism Relat Disord.* 2016 Sep;30:29-35.
8. Cryer PE. Mechanisms of Hypoglycemia-Associated Autonomic Failure in Diabetes. *N Engl J Med* 2013;369:362-72.
9. Sprague JE, Arbeláez AM. Glucose Counterregulatory Responses to Hypoglycemia. *Pediatr Endocrinol Rev.* 2011 September; 9(1): 463-475.
10. Van Cauter E, Blackman JD, Roland D, Spire JP, Refetoff S, Polonsky KS. Modulation of glucose regulation and insulin secretion by circadian rhythmicity and sleep. *J Clin Invest.* 1991 Sep; 88(3): 934-942.
11. Fineberg, S., Merimee, T. Acute metabolic effects of human growth hormone. *Diabetes* 1974 Jun; 23(6): 499-504.
12. Rizza RA, Mandarino LJ, Gerich JE. Effects of growth hormone on insulin action in man. Mechanisms of insulin resistance, impaired suppression of glucose production, and impaired stimulation of glucose utilization. *Diabetes.* 1982 Aug;31(8 Pt 1):663-9.