

Hyperglycaemia-related occipital lobe seizures

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Lesson

Recognition of the role of hyperglycaemia in seizures is vital, because they tend to be refractory to antiepileptic drugs and respond to insulin therapy and hydration.

Keywords

Clinical, diabetes, endocrinology, epilepsy and seizures, neurology

We aim to remind the reader of the importance of aggressive treatment of hyperglycaemia in patients who present with seizures. Recognition of the role of hyperglycaemia in seizures is vital, because such seizures tend to be focal, refractory to antiepileptic drugs and respond mainly to insulin therapy and hydration.^{1,2}

Case report

A 53-year-old woman presented to the emergency room for evaluation of six days of new-onset headaches. She had a medical history of poorly controlled type 2 diabetes mellitus, hypertension and Grave's disease. The headaches started suddenly, beginning in the left maxillary region and progressing to the left orbit with radiation to the left occipital region. There was no nausea, vomiting or photo-phonophobia. Severity ranged from 7 to 10/10. She simultaneously reported seeing coloured lights, described as a 'discotheque' in the right eye and obscuration of her right visual field. Her medications included: ASA 81 mg daily, levothyroxine 200 mcg daily and metformin 1 g.

Vital signs were within normal limits, including a blood pressure 145/85. EKG revealed a ventricular rate of 73 in normal sinus rhythm. Ophthalmologic exam revealed only glaucomatous optic nerves without evidence of anterior ischemic optic neuropathy to suggest temporal arteritis. A neurological exam revealed a dense right homonymous hemianopsia. Serum lab tests were notable for elevated glucose of 492, corrected sodium of 140, measured osmolality of

292 (275–295 mOsm/Kg), normal white cell count (WBC) of 8.7 (4.0–10.0 1000/mm³), normal CRP, elevated erythrocyte sedimentation rate (ESR) of 84 (0–30 mm/h), elevated thyroid stimulating hormone (TSH) of 16.44 (0.27–4.20 uIU/mL), low free thyroxine (FT4) of 0.83 (0.93–1.70 ng/dL) and elevated glycosylated Hgb (A1C) of 13.2% (4.8%–5.8%). Urine culture and blood cultures were negative. Additionally, a chest X-ray was unremarkable.

Brain MRI with and without contrast and with perfusion revealed elevated cerebral blood flow by ASL to the left parietal-occipital cortex without mass lesion or underlying structural abnormalities (Figure 1). Prolonged EEG revealed persistent sharp waves in the left occipital leads, consistent with epilepsy partialis continua (Figure 2).

Initial treatment for status epilepticus with intravenous levetiracetam (3 g) and valproic acid (20 mg/kg) loading doses followed by a maintenance of valproic acid (1 g BID) and Keppra of 1.5 g BID was unsuccessful in resolving the seizures. Subsequently, an insulin drip was initiated, with concordant electrographic and clinical improvement after achieving normoglycaemia. The patient was seizure and headache free within two days of admission. The hemianopsia persisted on discharge. On follow-up 10 months later, the patient's symptoms had resolved; she continued home insulin and antiepileptics (AEDs) were tapered. Visual field exam was normal. Repeat EEG one year later showed no evidence of seizures or epileptiform discharges.

Discussion

The hyperosmolar hyperglycaemic state (HHS) is defined as hyperglycaemia (>600 mg/dL) and hyperosmolality (>320 mOsm/L) without ketosis.³ Seizures are a rare complication of HHS and can be the initial manifestation of diabetes mellitus.² Seizures have also been reported in hyperglycaemia without significant hyperosmolality.^{4,5} Seizures in HHS usually manifest as focal motor seizures with/without loss of awareness; rarely, however, occipital seizures have been reported.^{6–9} We report a case of occipital lobe

Figure 1. Brain MRI performed on a 1.5 Tesla GE magnet system. From left to right, Axial T2-FLAIR demonstrating periventricular hyperintensities, diffusion-weighted imaging showing thin cortical ribboning of diffusion restriction (arrows) and colour perfusion demonstrating asymmetric elevated cortical blood flow within the left parieto-occipital lobe.

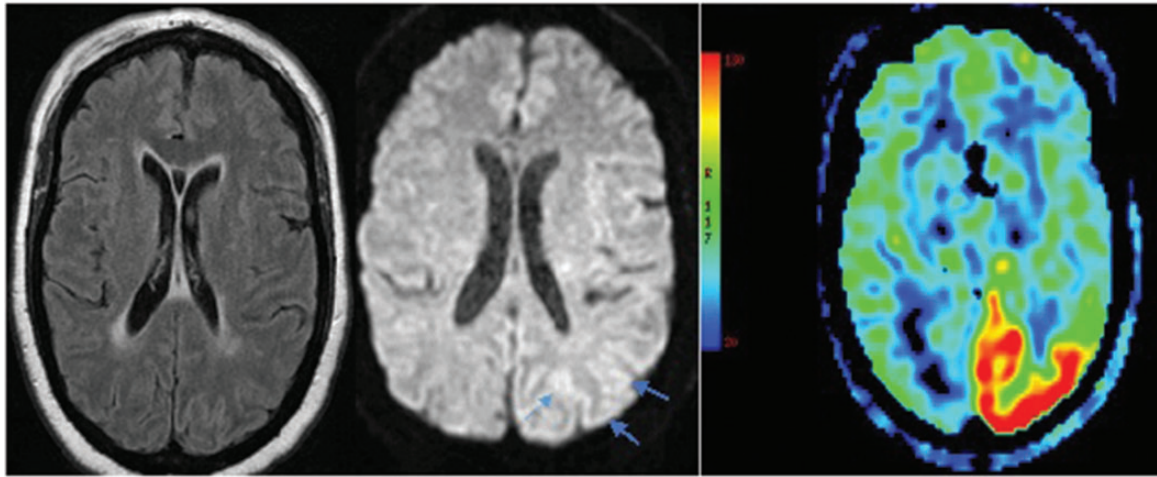


Figure 2. Electroencephalogram performed using disc electrodes and following the International 10-20 system of electrode placement showing rhythmic sharp waves in the left occipital region consistent with occipital lobe seizures (above) with resolution of seizures (below).



seizures secondary to hyperglycaemia that did not meet the criteria for HHS.

Diabetics with seizures usually present with seizure activity as the initial manifestation, and few (like our patient) present with headaches first.⁷ The differential diagnosis of headaches with associated visual symptoms includes occipital migraine and posterior reversible encephalopathy syndrome (PRES). Certainly, headaches and colourful visual auras are common in migraines. However, in migraine, the visual aura typically precedes the headache, and more importantly, migraines would not result in ictal EEG. Certainly, the sudden onset of headaches is not typical of hyperglycaemic seizures; however, occipital lobe seizures can have migraines features and can be indistinguishable from migraines.¹⁰ Furthermore, our patient had no history of migraines. Additionally, PRES can cause headaches with concurrent visual symptoms. However, this condition is typically associated with hypertension or other vascular risk factors and brain imaging in PRES typically shows vasogenic oedema affecting bilateral cortical and subcortical structures.¹¹ Other disorders in the differential include giant cell arteritis or central retinal artery occlusion; however, these conditions would cause vision loss in one eye rather than positive visual symptoms affecting a visual hemifield, which is consistent with a cortical pathology (such as seizures). Furthermore, although the patient's TSH is elevated, her T4 is only mildly low, and thus would not explain her seizures, as hypothyroidism rarely results in seizures except in severe cases such as in myxedema coma.¹² She had no fevers with normal WBC, and CRP count. Additionally, she had normal cultures. Thus, her elevated ESR is likely falsely elevated in the setting of diabetes, obesity (BMI 35.9) and status epilepticus.

Interestingly, most occipital lobe seizures in the setting of diabetes do not meet the criteria for HHS and are usually in the setting of hyperglycaemia without significant hyperosmolality,^{13,14} in which blood glucose ranges from 310 to 550 mg/dL, and osmolality ranges from 295 to 312 mg/dL.^{1,2,7,14} The most important factor is prolonged elevation in blood glucose, because A1c is generally high, and most cases report an A1c of 13.8%–14.8%.^{1,2,7,14} Brain MRI is frequently normal; however, MRI may show transient T2 hyperintensities and, as in our patient, diffusion-weighted imaging and perfusion changes are consistent with seizure activity.^{15,16}

The mechanism of seizures in hyperglycaemia is unknown.⁶ Interestingly, seizures are more likely to occur in HHS than diabetic ketoacidosis. This is likely secondary to the anti-epileptic effect of ketones. As stated above, prolonged exposure to a high

glycaemic state is likely the most important risk factor, because all patients with hyperglycaemia-induced seizures tend to have a severely elevated A1c with only mild-to-moderate elevations in osmolality and spot glucose.

In conclusion, we report a case of hyperglycaemic occipital lobe seizures. Recognition of the role of hyperglycaemia in seizures is vital, because such seizures tend to be refractory to AEDs and respond mainly to insulin therapy and hydration.^{1,2}

Declarations

Competing Interests: None declared.

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References

1. Wang X, Yu H, Cai Z, Wang Z, Ma B and Zhang Y. Nonketotic hyperglycemia-related epileptic seizures. *Epilepsy Behav Case Rep* 2013; 1: 77–78.
2. Rani KA, Ahmed MH, Dunphy L and Behnam Y. Complex partial seizure as a manifestation of non-ketotic hyperglycemia: the needle recovered from haystack? *J Clin Med Res* 2016; 8: 478–479.
3. Pasquel FJ and Umpierrez GE. Hyperosmolar hyperglycemic state: a historic review of the clinical presentation, diagnosis, and treatment. *Diabetes Care* 2014; 37: 3124–3131.
4. Hung W-L, Hsieh PF, Lee Y-C and Chang M-H. Occipital lobe seizures related to marked elevation of hemoglobin A1C: report of two cases. *Seizure* 2010; 19: 359–362.
5. Wang X. Nonketotic hyperglycemia-related epileptic seizures. *Chin Neurosurg J* 2017; 3: 16.
6. Verrotti A, Scaparrotta A, Olivieri C and Chiarelli F. Seizures and type 1 diabetes mellitus: current state of knowledge. *Eur J Endocrinol* 2012; 167: 749–758.
7. Raghavendra S, Ashalatha R, Thomas SV and Kesavadas C. Focal neuronal loss, reversible subcortical focal T2 hypointensity in seizures with a nonketotic hyperglycemic hyperosmolar state. *Neuroradiology* 2007; 49: 299–305.
8. Lavin PJ. Hyperglycemic hemianopia: a reversible complication of non-ketotic hyperglycemia. *Neurology* 2005; 65: 616–619.
9. Hennis A, Corbin D and Fraser H. Focal seizures and non-ketotic hyperglycaemia. *J Neurol Neurosurg Psychiatry* 1992; 55: 195–197.

10. Panayiotopoulos CP. “Migralepsy” and the significance of differentiating occipital seizures from migraine. *Epilepsia* 2006; 47: 806–808.
11. Bartynski WS. Posterior reversible encephalopathy syndrome, part 1: fundamental imaging and clinical features. *AJNR Am J Neuroradiol* 2008; 29: 1036–1042.
12. Gunatilake SSC and Bulugahapitiya U. Myxedema crisis presenting with seizures: a rare life-threatening presentation – a case report and review of the literature. *Case Rep Endocrinol* 2017; 2017: 4285457.
13. Sasaki F, Kawajiri S, Nakajima S, Yamaguchi A, Tomizawa Y, Noda K, et al. Occipital lobe seizures and subcortical T2 and T2* hypointensity associated with nonketotic hyperglycemia: a case report. *J Med Case Rep* 2016; 10: 228.
14. Hung WL, Hsieh PF, Lee YC and Chang MH. Occipital lobe seizures related to marked elevation of hemoglobin A1C: report of two cases. *Seizure* 2010; 19: 359–362.
15. Wang C-P, Hsieh PF, Chen CC-C, Lin W-Y, Hu W-H, Yang D-Y, et al. Hyperglycemia with occipital seizures: images and visual evoked potentials. *Epilepsia* 2005; 46: 1140–1144.
16. Seo DW, Na DG, Na DL, Moon SY and Hong SB. Subcortical hypointensity in partial status epilepticus associated with nonketotic hyperglycemia. *J Neuroimaging* 2003; 13: 259–263.