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Brief Communications

Visual Snow in Migraine With Aura: Further Characterization by Brain Imaging, Electrophysiology, and Treatment – Case Report

Isin Unal-Cevik, MD, PhD; F. Gokcem Yildiz, MD

Objective.—This study aims to investigate characteristics of visual snow accompanied by migraine and special interest on occipital bending, electrophysiological properties, and response to treatment.

Background.—Visual snow is characterized by continuous dynamically flickering dots in the visual field. Most patients also have comorbid migraine. Cortical hyperexcitability is a feature of migraine. Recent studies indicate an association between occipital bending with psychiatric disorders such as depression. Here, we demonstrate a patient with visual snow, migraine with aura, left occipital bending, and cortical hyperexcitability. Treatment response to lamotrigine was objectively assessed by repetitive pattern reversal visual evoked potentials (rVEP).

Methods.—A 25-year-old woman with a 10-year history of migraine with aura (2-3 attacks/week) admitted for 1-year history of visual snow. She reported continuous bright and colorful lights, palinopsia, floaters, nyctalopsia, and photopsia. Brain magnetic resonance imaging (MRI) was performed. Visual habituation response was assessed before and after lamotrigine treatment by rVEP.

Results.—Brain MRI revealed left occipital bending. On rVEP study, there was potentiation response. After lamotrigine treatment, the patient had no more complaints of visual snow, was able to sleep, and the frequency of migraine decreased to 2 attacks/month. Electrophysiologically, the cortical hyperexcitability was improved.

Conclusions.—The visual snow and loss of habituation ability in migraine associated with occipital bending can be improved with lamotrigine treatment. This report may provide new insights on "visual snow" pathophysiology in migraine.

Key words: headache, repetitive pattern-reversal visual evoked potential, occipital bending, cortical excitability, magnetic resonance imaging, anticonvulsant

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Migraine is one of the most common and burdensome primary headache disorders.[1] "Visual snow" is characterized by continuous dynamically flickering dots in the visual field for at least 3 months.[2] Although visual snow and typical migraine aura are distinct, there is a relation.[3] Most patients with visual snow are reported to have comorbid migraine.[2] Migraine is accompanied by nausea, vomiting, and light and sound sensitivity.[4] Compared to healthy controls, the brains of migraineurs are reported to be hyperexcitable.[5] On electrophysiological studies, repetitive pattern-reversal visual evoked potential (rVEP) predominates in migraineurs, a finding supported by evidence of lack of habituation to repeated stimuli interictally.[6] Sustained visual cortex hyperexcitability has also been demonstrated in persistent visual aura in migraineurs.[7]

From the Hacettepe University, Faculty of Medicine, Department of Neurology, Pain Unit, Ankara, Turkey (I. Unal-Cevik); Hacettepe University Institute of Neurological Sciences and Psychiatry, Ankara, Turkey (F.G. Yildiz).

Address all correspondence to I. Unal-Cevik, Hacettepe University, Faculty of Medicine, Department of Neurology, Pain Unit, Sıhhiye, Ankara 06100, Turkey.

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Structurally and functionally, the human brain is asymmetric, characterized by leftward volume asymmetry of the planum temporale and arcuate fasciculus.[8] The bending of the human brain interhemispheric fissure, protrusion and wrapping around of one occipital lobe relative to the other occipital lobe is termed "occipital bending."[9] Recent studies indicate an association between occipital bending with psychiatric disorders such as depression.[9]

Here, we demonstrate a patient with visual snow, migraine with aura, left occipital bending, and cortical hyperexcitability. Treatment response to lamotrigine was objectively assessed by repetitive pattern reversal visual evoked potentials (rVEP).

METHODS

A 25-year-old woman with a 10-year history of migraine with aura was admitted to our Neurology Department, Pain Unit, due to a 1-year history of visual snow. An informed signed consent was obtained from the patient. The patient described bright colors (white, light grey, yellow, pink) in the form of spots, strands, and swirls (floaters) in both of her eyes and entire visual field. During daytime, looking at the blue sky, she described fast moving white dots and strands (blue field entoptic phenomenon). She also described afterimages of the objects (palinopsia), impaired night vision (nyctalopia), and short flashing lights (photopsia). Dynamic, flickering white dots were the most bothersome visual symptom. It was continuously present even when her eyes were closed, and interrupted her sleep.

She reported 2-3 migraine attacks/week over the previous 3 months. Migraine attacks were unilateral, throbbing, severity of VAS: 8/10, associated with visual aura, nausea, vomiting, photophobia, phonophobia, increased by physical activity, and accompanied by cutaneous allodynia over the head. She had a comorbid anxiety disorder and was taking fluoxetine 40 mg/day for the last 2 months, without consumption of illicit drugs or hallucinogens. Family history of paternal migraine with aura was noted. Routine blood tests, electroencephalogram (EEG), and brain magnetic resonance imaging (MRI, including diffusion-weighted images) were performed.

In a standard VEP recording protocol, a minimum of 2 VEP waves are averaged by 200 stimuli recorded from Oz-Cz electrodes. To assess cortical hyperexcitability in this patient, we used a repetitive pattern reversal VEP technique. Basically, VEP response to uninterrupted visual stimuli at 3.1 Hz was recorded during 10 sequential blocks. Each block consisted of 100 averaged VEP responses.[10] To assess habituation or potentiation response, subaveraged peak-to peak amplitudes of N1P1 at blocks 5 and 10 were compared with that at block 1 (0-100 responses) (ie, significant decrease or increase at 5th and 10th blocks compared to the 1st block).

RESULTS

Physical and neurological examinations, routine blood tests, and standard and sleep deprivation EEGs were unremarkable. Brain MRI in T1-, T2-, Fluid-attenuated inversion recovery, and diffusion-weighted images revealed no lesions except hemisphere asymmetry, characterized by left occipital bending (Fig. 1). As a result of these brain MRI studies, we wanted to investigate if any relationship was present with occipital lobe cortical excitability and performed rVEP. To assess habituation or potentiation response, subaveraged peak-to-peak amplitudes at blocks 5 and 10 were compared with that at block 1. Before treatment, the amplitudes of the 1st and the 10th blocks were 13.3 mV and 19.4 mV on the left side and 10.8 mV, 15.7 mV on right side, respectively. Potentiation of habituation ratio was 45.03% on the left and 45.3% on the right (Figs. 2 and 3). For the treatment of visual snow, lamotrigine was gradually titrated up to 50 mg bid. After lamotrigine treatment, the 1st and the 10th blocks amplitudes were 11.6 mV, 14.3 mV on the left and 12.5 mV, 15.1 mV on the right side, respectively. Potentiation of habituation was reduced; the ratio was 23.7% on the left and 21.4% on the right (Figs. 2 and 3). After lamotrigine, the patient reported that palinopsia was improved by ~80%. The brightness and density of floaters, density, and frequency of flickering dots, and photopsia were partially improved (~50%); however, improvement in blue field entoptic phenomenon and impaired night vision (nyctalopia) were less (~30%). She reported

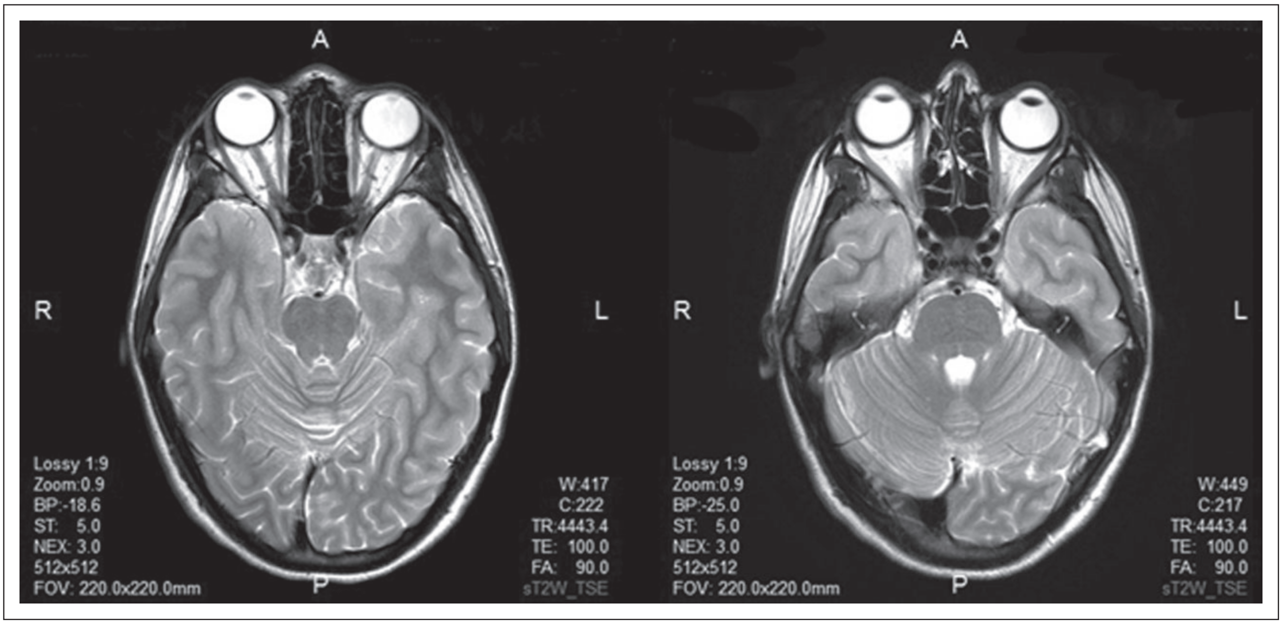

Fig 1.—Brain magnetic resonance imaging (MRI), axial, T2-weighted images, demonstrates left occipital lobe volume increase and left occipital bending.

that she was now able to sleep. The frequency of migraine attacks was decreased to 2 attacks per month.

DISCUSSION

We aimed to investigate clinical features, electrophysiological characteristics, and treatment response of visual snow in migraine with aura associated with occipital bending. Our patient had a history of frequent episodic migraine with aura for 10 years.

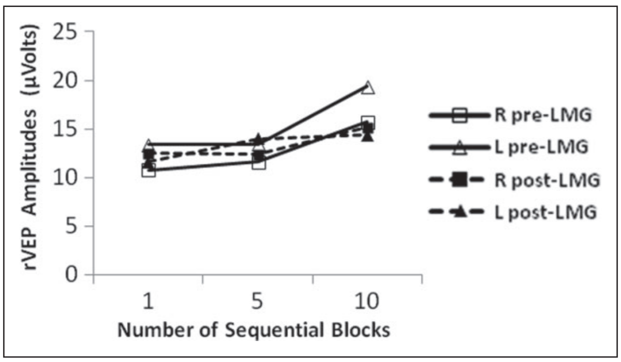

Fig 2.—Graphic representation of visual evoked potential (VEP) amplitudes (µvolts) at the 1st, 5th, and 10th blocks. R: right; L: left; Pre-LMG: before treatment with lamotrigine; post-LMG: After treatment with lamotrigine.

However, she was admitted due to disabling, constant, positive visual phenomenon consistent with visual snow.[2] Visual snow is regarded as a distinct entity from migraine aura; however, many patients are reported to have comorbid migraine, anxiety, or depression.[3] Our patient's visual symptoms interrupted her sleep for the last year. In order to exclude any underlying epileptic phenomena, we performed EEGs, which were normal.

To rule out any organic pathology, we performed brain MRI. Although there was no abnormal signal change on routine and diffusion-weighted images, we noticed an increase of left occipital lobe volume and left occipital bending. A difference of 1 mm or greater in length of hemispheres and extent of protrusion of one occipital pole (occipito-petalia) is defined as asymmetry.[11] In a study of 250 human skulls, occipital poles were reported to be symmetrical in 44%, left occipito-petalia in 36.8%, and right occipito-petalia in 19.2%.[12] This asymmetry may be noted by head computed tomography and brain MRI studies. To define the asymmetry index, lengths or widths of the occipital lobes have been measured and compared in previous studies. However, lobar length is not equivalent to lobar bending.[9] In right-handed healthy young

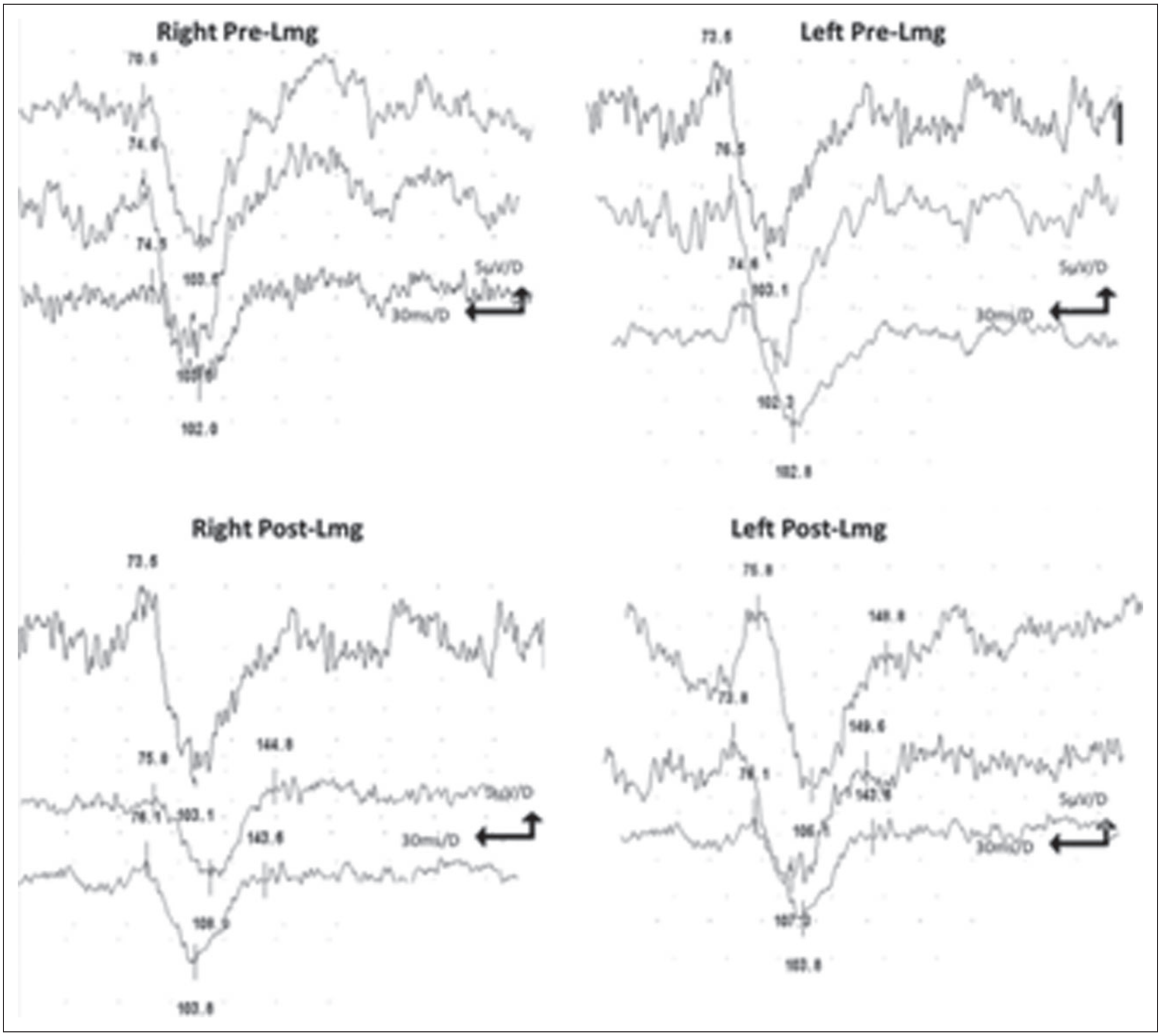

Fig 3.—Representative recordings of visual evoked potential (VEP) potentiation from right and left eyes, 1st, 5th, and 10th blocks, pre-lamotrigine and post-lamotrigine treatment. Pre-LMG: before treatment with lamotrigine; Post-LMG: After treatment with lamotrigine.

adults, gray and white matter brain asymmetry characterized by leftward volume asymmetry of the planum temporale and leftward asymmetry of the arcuate fasciculus was demonstrated by voxel-based morphometry and diffusion tensor imaging studies.[8] In a study of boys with developmental stuttering, occipital torque was reported to occur in 70-75% of the healthy population.[13]

Occipital lobe bending is defined as one of the occipital lobes crossing the antero-posterior axis, in which one "wraps" around the other hemisphere. Although occipital bending may relate to occipital size due to Yakovlevian torque, it is reported that they are clearly not the same entities.[9] In this study, occipital bending was found to be 3 times more frequent in major depressive disorder patients compared to the healthy control (35.3% vs 12.3%).[9] Similarly, occipital bending was found to be 4 times more frequent in bipolar disorder patients compared to the healthy control (35.3% vs 8.3%).[14] The visually inspected brain MRI axial images of our patient disclosed left occipital pole extension across the midline (interhemispheric fissure) and wrapping around the right, and were classified as "occipital bending."

Recent studies indicate an association between occipital bending with psychiatric disorders such as depression.[9] Our patient also reported a mood disorder. In a [18F]-2-fluoro-2-deoxy-D-glucose positron emission tomography study of 17 patients with visual snow, the lingual gyrus was reported to be hypermetabolic compared to age-matched healthy controls.[3] To our knowledge, this is the first reported case of visual snow with occipital bending. Although the clinical implication of this result is unclear, we think, large scale brain MRI volumetric studies may address whether occipital bending is associated or only a coincidence (not a causal relation) with visual snow.

There is no consensus on medical treatment for visual snow, and sertraline is reported to worsen the symptoms, whereas fluoxetine had no effect.[3] Our patient had a history of anxiety disorder and reported that she was taking fluoxetine for 2 months; however, her visual symptoms were present for 1 year, so we think that the fluoxetine had no effect on the visual snow. Lamotrigine is an anticonvulsant drug also known to be a good choice for mood disorders.[15] There is a report of 2 cases with persistent migrainous visual phenomena that were responsive to lamotrigine, and we treated our patient with lamotrigine.[16]

Again as already noted, compared to healthy controls, the brains of migraineurs are reported to be hyperexcitable, especially in the occipital cortex, demonstrated by functional MRI studies.[5] On electrophysiological studies, rVEP predominates in migraineurs, supported by lack of habituation to repeated stimuli interictally.[6] Sustained visual cortex hyperexcitability has also been demonstrated by magnetoencephalographic studies in persistent visual aura migraineurs.[7] In our patient's rVEP study, instead of habituation, a potentiation response was obtained, probably due to cortical hyperexcitability. By rVEP, we were able to demonstrate the treatment response objectively. Our patient had a 10-year history of migraine with aura, and reported 2-3 migraine attacks/week for the last 3 months. After lamotrigine treatment, the patient did no longer complain of visual snow, was able to sleep, and the frequency of migraine decreased to 2 attacks/month. This was a marked improvement but not complete cessation of visual snow. Electrophysiologically, the cortical hyperexcitability was also improved. During the rVEP recordings, the patient did not have a migraine attack or aura status but only visual snow. In this electrophysiological study, we still cannot eliminate the consequences of cortical hyperexcitability due to comorbid migraine and/or visual snow.

CONCLUSION

The visual snow and loss of habituation ability in migraine associated with occipital bending may be restored by lamotrigine treatment. This study may provide new insights on visual snow pathophysiology.

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STATEMENT OF AUTHORSHIP

Category 1.—

(a) Conception and Design
Isin Unal-Cevik

(b) Acquisition of Data
Isin Unal-Cevik; F. Gokcem Yildiz

(c) Analysis and Interpretation of Data
Isin Unal-Cevik; F. Gokcem Yildiz

Category 2.—

(a) Drafting the Article
Isin Unal-Cevik

(b) Revising It for Intellectual Content
Isin Unal-Cevik

Category 3.—

(a) Final Approval of the Completed Article
Isin Unal-Cevik; F. Gokcem Yildiz

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