Levetiracetam Induces a Rapid and Sustained Reduction of Generalized Spike-Wave and Clinical Absence

Jennifer Cavitt, MD; Michael Privitera, MD

Background: Levetiracetam (LEV) is a new antiepileptic drug with efficacy in partial-onset seizures. We report a case in which generalized-onset absence seizures responded clinically and electrographically to LEV.

Methods: We evaluated with continuous video/electroencephalography an adult with generalized-onset seizures given 3 antiepileptic drugs, 1 of which was LEV. Levetiracetam initiation 2 months before admission decreased patient-reported seizures. Interictal electroencephalography revealed generalized 3.5-Hz spike-wave and polyspike-wave discharges. Spike-wave bursts lasting 2 seconds or longer caused a pause in continuous reading aloud, consistent with clinical absence seizures. Levetiracetam was discontinued on admission, lamotrigine was gradually discontinued across 2 days, and topiramate was not changed. One encephalographer counted from video/electroencephalography recordings the number of spike-wave bursts in 1-hour time samples that included wake and sleep time.

Results: Spike-wave bursts increased from 4 to 56 per hour at baseline (4000 mg of LEV per day) to 406 to 914 per hour less than 48 hours after LEV discontinuation. Levetiracetam treatment was restarted, and 3 hours after the first dose of 1000 mg, spike-wave bursts dropped to 135 per hour. Response was sustained during the next 2 days.

Conclusions: This case showed a dramatic, rapid effect of LEV discontinuation and reinstitution on generalized spike-wave burst frequency and clinical absence. The effects were independent of reduction of lamotrigine and without change in topiramate doses and occurred in a time course consistent with LEV pharmacokinetics. Levetiracetam may be effective in generalized-onset epilepsy, and randomized, controlled trials are indicated.

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patient-reported seizures. Treatment with lamotrigine (LTG) for more than 8 months prior to admission had produced a modest reduction in patient-reported seizures. On admission, her LTG dose was 600 mg/d with a level of 3.9 µg/mL. Topiramate (TPM) therapy, 150 mg/d, was already in the process of being slowly discontinued owing to intolerable adverse effects with doses of up to 400 mg/d. A previous trial of valproic acid years before had produced “the best” seizure control according to the patient, but it also caused intolerable nausea, vomiting, and diarrhea. Renal and hepatic function were normal. Interictal EEG showed generalized 3.5-Hz spike-wave and polyspike-wave discharges with bitemporal predominance; intermittent polymorphic delta activity was also seen over the left temporal region. Magnetic resonance imaging showed slightly decreased volume and slightly increased signal in the right hippocampus compared with the left, although several images were limited owing to motion artifact. Full scale IQ was in the borderline range.

The patient was monitored with continuous video/EEG from January 2, 2002, at 6PM, to January 7, 2002, at 11AM. Levetiracetam therapy was discontinued on admission (last dose, January 2, 2002, before 12PM), LTG therapy was gradually discontinued across 2 days, and TPM therapy was not changed (Table). No generalized tonic-clonic seizures and none with the longer staring spells and moaning were observed. Numerous absence-type seizures were the only seizures captured on video/EEG. Generalized spike-wave bursts consistently lasting 2 seconds or longer (20 times in 4 minutes and 15 seconds) caused a detectable pause (losing her place) in continuous reading aloud (Figure 1), suggestive of absence seizures. One encephalographer counted from video/EEG recordings and hard copy EEG printouts the number of spike-wave bursts in 1-hour time samples that included both wake and sleep time. Of 1320 spike-wave bursts analyzed, 75% lasted 2 seconds or longer.

Table. Preadmission and Postadmission Antiepileptic Drug Dosing by Hospital Day*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Prior to Admission</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEV</td>
<td>4000</td>
<td>Discontinued upon admission (after 2000 mg morning dose at home)</td>
<td>1000 (at 4 PM)</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
</tr>
<tr>
<td>LTG</td>
<td>400 (level = 3.9 µg/mL)</td>
<td>100 (at 9 AM, then discontinued)</td>
<td>None</td>
<td>None (level &lt; 1.0 µg/mL)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>TPM</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>VPA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>500 (at 6 PM)</td>
<td>500 (first dose at 8 AM)</td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; LEV, levetiracetam; LTG, lamotrigine; TPM, topiramate; VPA, valproic acid.

*Data are presented as mg/d. Each hospital day represents a consecutive 24-hour period starting at 6 PM on January 2, 2002. Discharge on day 5, January 7, 2002, occurred at 11 AM.

Figure 1. Spike-wave bursts correlate with pauses in continuous reading aloud.

Spike-wave bursts occurred 4 to 56 times per hour during the first 36 hours. The frequency of spike-wave bursts increased to 406 to 914 per hour between 37 and 47 hours after LEV discontinuation (Figure 2). During this period, approximately 50% of the EEG findings were spike-wave bursts. The first dose of 1000 mg of LEV was given at 4PM on January 4, 2002, and the EEG analysis at 7PM showed 135 spike-wave bursts per hour. A continued decrease to 30 to 126 per hour was seen during the next 2 days, as the daily dose of LEV (but not LTG) was increased back to 100% of the baseline (maximum) dose.

Just prior to discharge, a retrial of valproic acid was initiated, despite the history of intolerable adverse ef-
effects with this medication, based on the history of best seizure control with valproic acid. At 1-month and 8-month follow-up visits on valproic acid and LEV, no quantitative reduction in seizure frequency was seen in patient seizure count reports. However, the patient and her family did report an increased awareness of absence seizures following evaluation in the epilepsy monitoring unit. Therefore, it is unclear whether this represents a true increase in absence seizures or just an increase in reporting. No intolerable adverse effects were reported following initiation of valproic acid therapy.

**COMMENT**

This single case showed a dramatic, rapid effect of LEV discontinuation and reinstitution on generalized spike-wave burst frequency and clinical absence. This effect occurred independently of reduction of LTG and without change in TPM doses, both of which are effective in generalized-onset seizures. Lamotrigine likely also affected this patient’s baseline seizure control because the spike-wave burst frequency decreased to an intermediate level (30-126/h) with restarting LEV and without restarting LTG. This represents more bursts than the baseline 4 to 56 per hour seen with discontinuing both LEV and LTG (TPM alone). The time course of these EEG changes appears to correlate with the expected pharmacokinetics of LEV. The half-life of LEV is 6 to 8 hours. Levetiracetam levels were not obtained, but renal elimination kinetics in a young patient with normal renal function predict that LEV should have been almost totally cleared from the blood by 30 to 40 hours. The highest spike rate was at 37 to 47 hours after LEV discontinuation, which would correspond to the predicted trough of LEV level. Levetiracetam peak effect is seen at 1 hour, and we began seeing reduction of spike-wave bursts by 3 hours.

Our patient clearly has absence-type seizures, based on clinical and electrographic criteria. However, her age at onset, clinical manifestation, and other seizure types do not correlate well with a known epilepsy syndrome. Based on the history and prolonged video/EEG results, she most likely has an unspecified generalized epilepsy. This analysis of generalized spike-wave frequency as a function of time and maximum LEV dose provides evidence that in this patient LEV dramatically reduced absence seizures in the acute setting. Accurate assessment of long-term absence seizure control was confounded by our inability to accurately count absence seizures as we could with simultaneous video/EEG monitoring. Given the problems with self-reporting of absence-type seizures, quantifying seizure frequency with video/EEG in the epilepsy monitoring unit provides more reliable documentation of clinical response in this patient, albeit during a very short period. Although the ability to generalize from single case studies is limited, this case suggests LEV may be effective in generalized-onset epilepsy and, more specifically, in absence-type seizures. Thus, further study with randomized, controlled trials is indicated.

**Figure 2.** Changes in spike-wave frequency and antiepileptic drug doses during hospitalization.
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