

# Lorcaserin therapy for severe epilepsy of childhood onset

## A case series

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Childhood-onset refractory epilepsies (e.g., Dravet syndrome [DS]) contribute to developmental delays, impaired quality of life, and increased mortality. We lack safe and effective antiseizure medications (ASMs) for these patients. Fenfluramine, an appetite suppressant, increases serotonin activity by releasing and inhibiting the reuptake of 5-HT and stimulating all 5-HT receptors. Combining fenfluramine with phentermine (Fen-Phen) led to sustained weight loss in obese patients, but pulmonary hypertension and heart valve lesions led to withdrawal. A small open-label trial with fenfluramine and a subsequent randomized trial found significant reductions in seizures in children with DS.<sup>1,2</sup>

Lorcaserin is a selective serotonin receptor (5-HT<sub>2C</sub>) agonist with receptors limited to the CNS. Mice lacking 5-HT<sub>2C</sub> receptors have a lower seizure threshold<sup>3</sup> and lorcaserin reduced seizures in a zebrafish DS model.<sup>4</sup> Lorcaserin does not affect cardiac valve 5-HT<sub>2B</sub> receptors and was Food and Drug Administration–approved for weight loss. We examined lorcaserin as a potential ASM in patients with DS and other severe childhood-onset epilepsies since we are unaware of any mechanism that would limit the potential antiseizure effects of serotonergic agonists to patients with *SCN1A* mutations.

## Methods

### Standard protocol approvals, registrations, and patient consents

NYU Langone Health (n = 24), Children's Hospital of Colorado (n = 6), and RWJ Barnabas Health (n = 6) collaborated on this retrospective chart review (January 2014 to January 2018). The institutional review board at each center approved the study.

Clinical data were abstracted from medical records including demographics, epilepsy diagnosis and treatments, lorcaserin dosage and effects, and potential drug interactions. Seizure frequencies were ascertained from caregiver reports in patient charts. Tonic, tonic-clonic, focal seizures with prominent motor features, and drop (atonic) seizures were used for the primary efficacy outcome. The primary efficacy outcome was median percentage change in the mean monthly frequency of these motor seizures from baseline to last observation on lorcaserin. A 2-tailed Wilcoxon signed rank test assessed pretreatment/posttreatment changes.

## Results

Of the 36 lorcaserin-treated patients, one was excluded from efficacy analysis because of discontinuation after 3 days due to side effects. Of the 35 remaining patients, 18 were female and treatment onset was 3–40 years (mean 16.4 years). Diagnoses included DS (n = 20),

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Lennox-Gastaut syndrome (LGS) (n = 9), and other treatment-resistant focal epilepsies (n = 3) and generalized epilepsies (n = 3). Thirty-three (94.3%) patients were taking  $\geq 1$  ASM (mean 3; clobazam [60%], valproic acid [57.1%], and cannabidiol [40%]).

Among our 35 patients, median percentage reduction in the mean monthly frequency of motor seizures from baseline was 47.7% ( $z = -3.04$ ,  $p < 0.01$ ; 46.9% in tonic-clonic, 62.3% in tonic, 60.1% in atonic, and 54.6% in focal seizures with motor features); 15 (42%) had a  $>50\%$  reduction in motor seizures. Two (5.7%) patients had increased seizure frequency. The mean lorcaserin dosage was 15.7 mg/d (and 13.7 mg/d for children) and median treatment duration was 10.8 months. After 15 months, 50% of patients remained on lorcaserin (figure).

The most common adverse events were decreased appetite (19.6%), decreased attentiveness (17.1%), and weight loss (11.1%). The mean decline in body mass index at last follow-up compared to baseline was  $-0.58 \pm 0.24$  kg/m<sup>2</sup> ( $-2.7 \pm 1.3\%$ ;  $p = 0.02$ ) and was similar among patients taking or not taking valproate. Five patients stopped treatment before 30 days due to side effects.

## Discussion

Our retrospective case series found that the selective 5-HT<sub>2C</sub> agonist lorcaserin may reduce motor seizures in children and young adults with treatment-resistant epilepsies. Lorcaserin was associated with a reduction of motor seizures in all groups: 50% in LGS, 43% in DS, and 23% in other epilepsies. Assuming a 10%–20% placebo response rate in epilepsy

trials,<sup>5</sup> the LGS and DS groups appear to have a clinically significant improvement.

Serotonergic therapies may have proconvulsant or anticonvulsant properties in animal models and small case series.<sup>1,6</sup> A meta-analysis of clinical trials found that patients randomized to second-generation antidepressants (excluding bupropion) had fewer seizures than those on placebo.<sup>7</sup> Open-label and randomized trials show fenfluramine reduces convulsive seizures in DS.<sup>1</sup> We included patients without DS since there is no mechanism to account for a selective efficacy of a serotonergic agonist in seizures due to *SCN1A* mutations.

Lorcaserin was well-tolerated in our patients. Adverse events reported by  $>10\%$  of patients were decreased appetite and attentiveness and weight loss. The patient excluded from the efficacy analysis developed serious behavioral side effects likely due to concomitant sertraline, suggesting serotonin syndrome. Another patient taking fluoxetine experienced no adverse events but stopped treatment before 30 days due to limited efficacy. The off-label use of lorcaserin was limited by high cost and limited insurance coverage, leading some families to discontinue therapy.

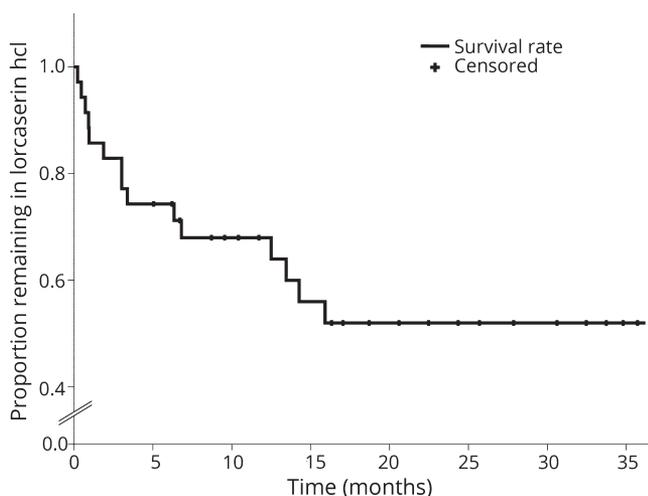
This study was limited by retrospective data collection, no control group or blinding, and small sample size. There was variation in both the timing of patient assessments and the consistency of clinical features. Caregiver reports are subject to recall bias. Patients did not undergo systematic evaluations before and after initiation of lorcaserin therapy (e.g., trough ASM levels, liver function tests, EEG). Adverse events were not systematically collected. ASM changes or other therapeutic adjustments may have affected seizure frequency. Interactions between ASMs or other concomitant medications and lorcaserin were not analyzed.

These promising preliminary findings support the need for randomized, controlled trials of lorcaserin for treatment-resistant epilepsies.

## Author contributions

P. Tolete: study design, acquisition of data, analysis and interpretation of data, drafting or revising the manuscript for intellectual content. K. Knupp: study design, acquisition of data, analysis and interpretation of data, drafting or revising the manuscript for intellectual content. M. Karlovich: analysis and interpretation of data, drafting or revising the manuscript for intellectual content. E. DeCarlo: acquisition of data, analysis and interpretation of data. J. Bluvstein: acquisition of data, analysis and interpretation of data. E. Conway: acquisition of data, analysis and interpretation of data. D. Friedman: analysis and interpretation of data, drafting or revising the manuscript for intellectual content. P. Dugan: analysis and interpretation of data, drafting or revising the manuscript for intellectual content. O. Devinsky: study design, acquisition of data, analysis and interpretation of data, drafting or revising the manuscript for intellectual content.

**Figure** Kaplan-Meier plot demonstrating retention rate of patients started on lorcaserin HCl



+Patients who were still receiving treatment at the time of efficacy review.

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