Case Report

Improved seizure control and regaining cognitive milestones after vagus nerve stimulation revision surgery in Lennox–Gastaut syndrome

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1. Introduction

Lennox–Gastaut syndrome (LGS) is one of the most challenging epilepsies to manage, due to a range of different seizure types which are frequently refractory to anti-seizure drug treatment. In patients with drug-resistant epilepsy, treatment options other than anti-seizure drugs are often considered; including epilepsy surgery, vagus nerve stimulation (VNS) therapy and a ketogenic diet.

We report a case of a boy with LGS and drug-resistant epilepsy responding to VNS therapy that is remarkable in several ways.

2. Case study

A now 16-year-old boy with a LGS, associated with an ARGHAP35 gene mutation, reached all developmental milestones until the age of 13 months. Then he had his first cluster of seizures. Seizures consisted of 6–7 tonic seizures and numerous atonic seizures and myoclonia daily, and soon became drug resistant. His developmental status rapidly deteriorated to a severe psychomotor retardation. His EEG demonstrated an epileptic encephalopathy with multifocal high amplitude spike and wave discharges. Brain MRI, MRS, EMG, VEP, as well as neurometabolic and genetic analysis were unremarkable at that time.

He was previously treated with multiple anti-seizure drugs (phenobarbital, pyridoxine, valproate, nitrazepam, clobazam, lamotrigine, carbamazepine, levetiracetam, topiramate, ethosuximide), and additionally the ketogenic diet, all without any significant effect. At the age of five years a VNS system (generator type 102, lead type 302, Cyberonics (now LivaNova), Houston, USA) was implanted. Hereafter, he was more alert, his seizure frequency decreased, and he started to regain developmental milestones. Fifteen months later, seizure frequency increased and his psychomotor skills again deteriorated.

When controlling the stimulator parameters, a high DC code (of 7) was measured. This suggested a high impedance either due to perineural gliosis at the electrode–vagus nerve interface or due to lead breakage. A disconnection between lead and generator was identified and surgically repaired. During this procedure, the VNS generator (2 years old) was replaced prophylactically. Intraoperative device testing was uneventful. He did well for several months, but then seizure frequency again increased, with loss of alertness and developmental arrest. EEG was consistent with a severe epileptic encephalopathy with slow spike-and-waves, compatible with LGS. Optimizing the VNS parameters (output current 1.75 mA, frequency 30 Hz, pulse duration 500 μs, signal on time 30 s, signal off time 1.8 min) had no beneficial effect. As the VNS system was controlled several times a year, always without any indication of a technical failure, we assumed VNS was no
3. Discussion

Parents and caregivers.

It is crucial for parents and caregivers to actively discover their environment, grab, and hold the child. Moreover, for the child, this is a completely new situation for his development and his psychomotor development. We did not change or add any anti-seizure medication or start another therapy. He has again shown progressive psychomotor development. However, for the first time in his 16-year-old life, he is now alert and active. He discovers his environment, uses his own voice, grabs, throws, and plays with toys, and has started to walk and understand simple instructions, clearly a completely new situation for his parents and caregivers.

4. Conclusion

VNS therapy in our patient was associated with cessation of status epilepticus, seizure freedom, and restored psychomotor function. System assessment during programming the VNS may not always detect lead dysfunction which should therefore be considered if seizure recurrence and loss of psychomotor skills occur in previously effective VNS therapy without any alternative explanation. In our case of LGS with 8 months of follow-up, we found that complete VNS revision (lead removal and subsequent replacement) if performed correctly may yield excellent results without clinically relevant side effects even in the most challenging cases.

Fig. 1. (A–B): Two 14-s fragments of the patients’ electroencephalograms showing the patterns before and after activation of the VNS. Fragment (A) shows an electroencephalographic-pattern status epilepticus. Fragment (B) is from the patients’ electroencephalogram after VNS activation showing marked slowing of background activity and few epileptiform discharges in the right temporal region.
using newer models sensing heart rate correctly may yield excellent results without clinically relevant side effects.

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Conflict of interest

E. Cornips has a consultancy agreement with LivaNova, the company that produces the VNS hardware. The other authors have no conflict of interest to disclose. No funding was obtained.

We confirm that we have read the Journals’ position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

Ethical statement

We ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). We have included a statement in the manuscript that informed consent was obtained from the patients’ parents.

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