Vagal nerve stimulation in New Zealand: improvement of seizure control following the implantation of a vagal nerve stimulator

Vagal nerve stimulator (VNS) is a form of neuro-stimulation therapy that was approved for use in medication refractive epilepsy in patients not eligible for resective epilepsy surgery in Europe and the United States in the mid 1990s. A number of well-designed international trials support the efficacy of this treatment. Despite these positive trial results access to VNS in New Zealand is limited and currently not readily funded by the government. We would like to report the outcome of, what we believe to be the first government funded adult VNS implantation in New Zealand.

The patient is a 31-year-old man with symptomatic localisation related epilepsy due to a dysembryonic neuro-epithelial tumour diagnosed during childhood. Seizures started prior to tumour diagnosis and continued despite initial tumour resection, a second resection in an attempt to quell the epileptogenic focus, and trials with virtually all anti-epileptic medications available in New Zealand. The patient suffers from a variety of seizure types including auras, simple partial seizures (SPSs) affecting right upper limb motor function without alteration of consciousness, complex partial seizures (CPSs) affecting right upper limb motor function with alteration in consciousness, and generalised tonic clonic seizures (GTCs). Due to his epilepsy he has been unable to pursue a career or hold a steady job in the past despite normal intellectual ability.

In 2008 seizure frequency escalated resulting in multiple emergency department visits and admissions. At that stage the option of further resective surgery was rejected due to the low likelihood of further benefit and high risk of resultant hemiparesis given the close proximity of his epileptogenic focus to the motor strip. VNS was subsequently considered and funding was eventually approved by the patient’s home district health board (Whanganui DHB). The VNS was implanted at Wellington Hospital in July of 2009 under the guidance of the MidCentral Health neurology team.

To assess the effect of the VNS in the patient both hospital records and detailed patient seizure diaries from 18 months before to 24 months after VNS implantation were reviewed.

Variables considered include: monthly frequency CPSs, GTCs, days with any seizure, days with ≥10 seizures, doses of rectal diazepam and emergency department visits.

After implantation of the VNS the average monthly frequency of CPSs reduced by 94% with only two CPSs in the most recent seven months. The patient did not experience a single GTC over the final 13 months of the reviewed period with an overall 85% reduction in monthly GTC seizure frequency after VNS implantation. SPS and aura frequency are harder to quantify in this patient as he often experiences them for hours in a row introducing inaccuracies when attempting to count them individually.
In an attempt to quantify SPSs he was instructed to group days by either ≥10 or <10 SPS/auras per day as an indicator of severity. In contrast to the first two variables there was a 32% increase in this variable following VNS implantation. However, overall the total number of days with any type of seizure per month remained reduced by 26% following the implantation of the VNS.

Surrogate markers for seizure severity include rectal diazepam use and emergency department visits. The patient routinely uses rectal diazepam (10mg) when he experiences a frequency of seizures that causes significant physical discomfort; however, he tries to limit diazepam use as best as possible due to its side effects of drowsiness rendering him unable to participate in routine tasks for the remainder of the day after using it.

Therefore diazepam use serves as a good indirect indicator of seizure frequency/severity and functional outcome. As with seizure frequency subsequent to VNS implantation there was a 32% reduction in average monthly diazepam use.

Unsurprisingly, correlating with the marked reduction in GTCs there was a dramatic reduction in emergency department after VNS implantation of 77%.

Table 1. Summary of percentage improvement in variables studied.

<table>
<thead>
<tr>
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<th>Complex Partial Seizures</th>
<th>Generalised Seizures</th>
<th>Doses Of 10mg Diazepam</th>
<th>Total Seizure Days</th>
<th>ED Visits</th>
<th>Seizure &gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Monthly - pre VNS</td>
<td>50.3</td>
<td>2.2</td>
<td>23.9</td>
<td>18.4</td>
<td>0.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Avg Monthly - post VNS</td>
<td>3.0</td>
<td>0.3</td>
<td>16.1</td>
<td>13.4</td>
<td>0.2</td>
<td>5.8</td>
</tr>
<tr>
<td>% improvement</td>
<td>94</td>
<td>85</td>
<td>32</td>
<td>26</td>
<td>77</td>
<td>-32</td>
</tr>
</tbody>
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This case highlights the significant benefit that patients can experience in response to VNS implantation. It also reiterates the typical outcome seen with VNS: seizures are not cured, but significantly reduced to the point of dramatic changes in quality of life and potential reduction in burden on society.

While this patient demonstrated a mild increase in SPS his significantly more disabling GTCs and CPSs and concomitant reduction in diazepam use allowed him to subsequently start pursue an informatics degree and safely help to take care of his infant son. The reduction in emergency department presentations not only underscore the improved quality of life for the patient and his family, but also demonstrate a substantial reduction in treatment cost to the public health sector.

We hope that these results replicating international evidence in a New Zealand patient will highlight the need to improve access to this effective therapy for carefully selected New Zealanders suffering from intractable epilepsy.
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References: