

Vagus Nerve Stimulation Versus Responsive Neurostimulator System in Patients with Bilateral Temporal Lobe Epilepsy

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Introduction

Patients with medically refractory bitemporal epilepsy are candidates for neuromodulation procedures. While vagus nerve stimulation (VNS) was historically the procedure of choice for this condition, in recent years the responsive neurostimulation system (RNS) has come into favor for its more targeted approach. While both VNS and RNS have been reported to have good efficacy in temporal epilepsy, the outcomes of these two procedures have not been directly compared. The goal of this study was to compare outcomes following VNS versus RNS for temporal lobe epilepsy.

Methods

We retrospectively reviewed the records of all patients with temporal lobe epilepsy who underwent VNS or RNS placement at Massachusetts General Hospital between 2003 and 2018. The primary outcome was change in seizure frequency. Other outcomes included Engel score, change in anti-epileptic medications, and complications. Continuous variables were compared using a two-sample t-test and categorical variables were compared using chi-square test.

Results

Twenty-three patients met inclusion criteria. Of these, 11 were treated with VNS and 12 with RNS. At baseline (Table 1), the two groups were statistically similar in terms of age at surgery, epilepsy duration, and pre-operative seizure frequency. Mean follow-up length was longer in the VNS group by about 30 months.

At last follow-up, both groups displayed reduced seizure frequency (Table 2). Responder rate (seizure reduction greater than 50%), Engel score, and change in AEDs were also statistically similar between groups.

Table 1. Demographics and baseline characteristics of patients treated with VNS and RNS.

	VNS group (n = 11)	RNS group (n = 12)	P value
Gender * (% male)	54.5% (n = 6)	66.7% (n = 8)	p = 0.55
Age at surgery (mean years)	38.8 ± 16.7	39.2 ± 12.1	p = 0.94
Epilepsy duration (mean years)	19.9 ± 12.0	12.8 ± 9.4	p = 0.13
Pre-op seizure frequency (mean / month)	33.5 ± 33.2	36.3 ± 54.7	p = 0.89
Pre-op meds (mean number)	3.0 ± 0.8	2.7 ± 0.8	p = 0.32
Follow up length (mean months)	76.6 ± 44.6	43.6 ± 39.1	p = 0.07

Unless otherwise specified, statistical test was two-sample t-test. * denotes chi-square test

Table 2. Seizure control outcomes in patients treated with VNS and RNS.

	VNS group (n = 11)	RNS group (n = 12)	P value
Post-op seizure frequency (mean / month)	16.3 ± 18.9	11.8 ± 18.4	
Change in seizure frequency (mean / month)	- 17.2 ± 34.3	- 24.5 ± 48.8	p = 0.69
Responder rate *	45.5% (n = 5)	66.7% (n = 8)	p = 0.31
Seizure reduction	46.3 ± 40.9%	58.1 ± 38.7%	p = 0.49
Engel score ** (mean)	3.2 ± 0.9	3.2 ± 0.4	p = 0.57
Engel I	9.1% (n = 1)	0%	
Engel II	0%	0%	
Engel III	54.5% (n = 6)	83.3% (n = 10)	
Engel IV	36.4% (n = 4)	16.7% (n = 2)	
Post-op meds (mean number)	3.1 ± 0.8	2.9 ± 0.6	
Change in number of meds	+ 0.1 ± 0.5	+ 0.3 ± 0.5	p = 0.50

Unless specified, statistical test was two-sample t-test. * denotes chi-square test, ** denotes Wilcoxon rank-sum test

To control for different follow-up durations between the two groups, we compared seizure frequency after one year of treatment; at this time point, the RNS group had greater mean seizure reduction but similar responder rates.

Table 3. Seizure outcomes following one year of treatment.

	VNS group (n = 9)	RNS group (n = 8)	P value
Gender * (% male)	55.6% (n = 5)	62.5% (n = 5)	p = 0.77
Age at surgery (mean years)	40.7 ± 17.9	35.9 ± 12.9	p = 0.54
Epilepsy duration (mean years)	20.6 ± 13.3	9.0 ± 5.3	p = 0.04
Follow-up length (mean months)	13.9 ±2.8	12.3 ± 1.7	p = 0.17
Pre-op seizure frequency (mean / month)	32.9 ± 35.0	22.5 ± 24.2	p = 0.49
Post-op seizure frequency (mean / month)	21.2 ± 29.8	3.0 ± 1.7	
Change in seizure frequency (mean / month)	-11.7 ± 12.9	- 19.5 ± 23.5	p = 0.40
Seizure reduction	44.4 ± 34.3%	68.8 ± 34.0%	p = 0.16
Responder rate *	55.5% (n = 5)	75.0% (n = 6)	p = 0.40

Unless otherwise specified, statistical test was two-sample t-test. * denotes chi-square test

Conclusions

Despite their different mechanisms, VNS and RNS resulted in similar response rates for patients with temporal lobe epilepsy. Responder rates for both groups decreased slightly between the one-year time point and last follow-up. While these trends warrant further investigation, they suggest that the shorter follow-up duration in our RNS group is not a major contributor to our observed non-superiority of RNS. We suggest that VNS should not be excluded as a treatment for patients with medically refractory TLE who are not candidates for resective or ablative procedures.