

# Comparative Study of Vagus Nerve Stimulation and Responsive Neurostimulation in Patients with Focal (Partial) Epilepsy

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## Introduction

Neuromodulation with vagus nerve stimulation (VNS) and responsive neurostimulation (RNS) has developed as a safe and effective treatment strategy for medically intractable epilepsy (Ben-Menachen et al., 1994; Bergey GK et al, 2015). Both are utilized in selected cases of focal epilepsy, but a study comparing their efficacy has not been undertaken. A single institutional retrospective study seeks to provide insight into the comparative value of each application.

## Methods

30 patients (M:14 F:16, median age 28 years) with medically intractable focal epilepsy underwent either VNS (n=13, F:6, M:7, mean years with epilepsy: 27.6) or RNS (N=17 F:10 M:7, mean years with epilepsy:35.4) placement at a single institution during a four year interval (2012-2016). They were evaluated postoperatively with mean follow up of 19 months while maintained on their preoperative antiepileptic medical regimen. Major and minor complications and seizure frequency reduction were identified.

## Results

There were no statistically significant differences in gender, age, years with epilepsy, length of follow-up and average monthly seizure frequency between the VNS and RNS groups (p=0.093-0.89). The mean seizure frequency reduction (VNS 66%: range 0-100%; RNS 58%, range 0-100% p=0.87) and seizure freedom (23% vs 15% p=0.67) was similar for both groups. There was no major morbidity or mortality in either group. Risk of minor complications was similar in both groups (VNS 23%; RNS 18% p>0.9).

## Learning Objectives

- By the conclusion of this session, the participant should be able to:
1. determine the efficacy of neuromodulation for seizure control in patients with complex partial epilepsy
  2. describe the complications associated with neuromodulation used for seizure control
  3. determine what further studies are needed to determine the safest and most efficacious neuromodulatory treatment of focal (complex) epilepsy

## Conclusions

We found the mean seizure frequency reduction to be similar for VNS and RNS applications but with a trend toward greater seizure freedom in the RNS group. Furthermore, the presumably increased morbidity associated with intracranial implants was not apparent in our study. Larger prospective studies with longer follow-up are needed as the benefits of neuromodulation accrue over time. Other metrics must assess generator replacement, cost, and quality-of-life.

## References

- Forsgren L, Beghi E, Oun A, et al. The epidemiology of epilepsy in Europe—a systematic review. *Eur J Neurol* 2005;12:245–53.
- Kwan P, Brodie MJ. Early identification of refractory epilepsy. *N Engl J Med* 2000;342:314–19.
- Fornai F, Ruffoli R, Giorgi FS, et al. The role of locus coeruleus in the antiepileptic activity induced by vagus nerve stimulation. *Eur J Neurosci* 2011;33:2169–78.
- Ben-Menachem E, Mañon-Espaillet R, Ristanovic R, et al. Vagus nerve stimulation for treatment of partial seizures: 1. A controlled study of effect on seizures. *Epilepsia* 1994;35:616–26.
- Handforth A, DeGiorgio CM, Schachter SC, et al. Vagus nerve stimulation therapy for partial-onset seizures: a randomized active-control trial. *Neurology* 1998;51:48–55.
- Bergey GK, Morrell MJ, Mizrahi EM, et al. Long-term treatment with responsive brain stimulation in adults with refractory partial seizures. *Neurology* 2015;84:810–17.
- Kuba R, Brázdil M, Kalina M, et al. Vagus nerve stimulation: longitudinal follow-up of patients treated for 5 years. *Seizure* 2009;18:269–74.
- Elliott RE, Morsi A, Kalhorn SP, et al. Vagus nerve stimulation in 436 consecutive patients with treatment-resistant epilepsy: long-term outcomes and predictors of response. *Epilepsy Behav* 2011;20:57–63.