­­Improving autonomic balance by decreasing sympathetic activity and increasing parasympathetic activity is of intense interest in the research community. Improved autonomic balance reduces inflammation implicated in medical conditions from cardiovascular disease to depression, to cancer, to aging. Efforts to “hack” the autonomic nervous system with implanted vagal nerve stimulators have had some success. Transcutaneous Auricular Vagal Nerve Stimulation has the promise of being a safe alternative since it relies on noninvasive afferent input to a peripheral branch of the vagus. Recent research[[1]](#endnote-1) has helped to define best parameters for TAVNS treatment, including frequency, intensity, electrode placement and timing. As with any treatment modality, however, individual patient variation can affect the efficacy of implanted vagal nerve stimulators and TAVNS. There are some exploratory investigations using heart rate variability (HRV) as feedback for implanted vagal nerve stimulation[[2]](#endnote-2)[[3]](#endnote-3) and for TAVNS also[[4]](#endnote-4) Acupuncture has been shown to improve autonomic balance[[5]](#endnote-5), so the hypothesis was that TAVNS added to it would further improve HRV and autonomic balance.

Materials and Methods:

Protocol: Patients monitored (HRV) in supine position for 5 minute baseline and then for entire treatment including TAVNS application, needling and resting with needles in for additional 20 minutes. TAVNS applied using clip electrode on the cymba concha bilaterally, and in some instances unilaterally. Frequency of TAVNS varied between, 1 hz, 25Hz, or 100 hz. HRV analysis of 3 minute segments during treatment using several HRV parameters including time, frequency and nonlinear analysis. 1 minute segments for DFAα1 ( a nonlinear parameter) were also charted.

Results:

There was individual patient variation in HRV response with added TAVNS. Patients who showed the most improvement were those who had low HRV to start. Variables that might affect efficacy of TAVNS will be discussed.

Discussion:

The hypothesis that TAVNS would improve HRV did not hold up in all patients. Of the HRV parameters measured and recorded, DFAα1 over one minute segments had the strongest signal/noise ratio so was the most promising as a measure.Furthermore, HRV analysis might have the potential to determine best TAVNS parameters for treatment such as intensity, frequency, duration etc… Individual patients’ HRV data will be presented and discussed.

Conclusions:

TAVNS did not improve HRV in all patients so HRV may help to better define which patients would benefit most from TAVNS. DFAα1 was found to be the most reliable HRV measure.

1. [Current Directions in the Auricular Vagus Nerve Stimulation II – An Engineering Perspective](https://www.frontiersin.org/articles/10.3389/fnins.2019.00772/full) Front Neurosci 13.772 July 24 2019

   [*Eugenijus Kaniusas*](http://loop.frontiersin.org/people/626382/overview)*1\*,* [*Stefan Kampusch*](http://loop.frontiersin.org/people/540374/overview)*1,2 et al,* [*Marc Tittgemeyer*](http://loop.frontiersin.org/people/14347/overview)*3,4*  [↑](#endnote-ref-1)
2. [PLoS One.](https://www.ncbi.nlm.nih.gov/pubmed/29077707) 2017 Oct 27;12(10):e0186068. doi: 10.1371/journal.pone.0186068. eCollection 2017.

   [**A novel controller based on state-transition models for closed-loop vagus nerve stimulation: Application to heart rate regulation.**](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5659642/)

   [**Romero-Ugalde** HM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Romero-Ugalde%20HM%5BAuthor%5D&cauthor=true&cauthor_uid=29077707)1,2, [Le Rolle V](https://www.ncbi.nlm.nih.gov/pubmed/?term=Le%20Rolle%20V%5BAuthor%5D&cauthor=true&cauthor_uid=29077707)1,2, [Bonnet JL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Bonnet%20JL%5BAuthor%5D&cauthor=true&cauthor_uid=29077707)3, et al [↑](#endnote-ref-2)
3. [Sci Rep.](https://www.ncbi.nlm.nih.gov/pubmed/29497072) 2018 Mar 1;8(1):3856. doi: 10.1038/s41598-018-21669-3.

   #### [Preoperative Heart Rate Variability as Predictors of Vagus Nerve Stimulation Outcome in Patients with Drug-resistant Epilepsy.](https://www.ncbi.nlm.nih.gov/pubmed/29497072)

   [Liu HY](https://www.ncbi.nlm.nih.gov/pubmed/?term=Liu%20HY%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)1,2, [Yang Z](https://www.ncbi.nlm.nih.gov/pubmed/?term=Yang%20Z%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)1, [Meng FG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Meng%20FG%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)3,4, [Guan YG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Guan%20YG%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)5, [Ma YS](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ma%20YS%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)6, [Liang SL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Liang%20SL%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)7, [Lin JL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Lin%20JL%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)8, [Pan LS](https://www.ncbi.nlm.nih.gov/pubmed/?term=Pan%20LS%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)7, [Zhao MM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Zhao%20MM%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)9, [Qu W](https://www.ncbi.nlm.nih.gov/pubmed/?term=Qu%20W%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)1, [Hao HW](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hao%20HW%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)1, [Luan GM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Luan%20GM%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)5, [Zhang JG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Zhang%20JG%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)4, [Li LM](https://www.ncbi.nlm.nih.gov/pubmed/?term=Li%20LM%5BAuthor%5D&cauthor=true&cauthor_uid=29497072)10,11,12,13. [↑](#endnote-ref-3)
4. [brain Stimul.](https://www.ncbi.nlm.nih.gov/pubmed/30803865) 2019 Feb 10. pii: S1935-861X(19)30056-7. doi: 10.1016/j.brs.2019.02.003. [Epub ahead of print]

   **The influence of respiration on brainstem and cardiovagal response to auricular vagus nerve stimulation: A multimodal ultrahigh-field (7T) fMRI study.**

   [Sclocco R](https://www.ncbi.nlm.nih.gov/pubmed/?term=Sclocco%20R%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)1, [Garcia RG](https://www.ncbi.nlm.nih.gov/pubmed/?term=Garcia%20RG%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)2, [Kettner NW](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kettner%20NW%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)3, [Isenburg K](https://www.ncbi.nlm.nih.gov/pubmed/?term=Isenburg%20K%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)4, [Fisher HP](https://www.ncbi.nlm.nih.gov/pubmed/?term=Fisher%20HP%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)4, [Hubbard CS](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hubbard%20CS%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)4, [Ay I](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ay%20I%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)4, [Polimeni JR](https://www.ncbi.nlm.nih.gov/pubmed/?term=Polimeni%20JR%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)4, [Goldstein J](https://www.ncbi.nlm.nih.gov/pubmed/?term=Goldstein%20J%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)5, [Makris N](https://www.ncbi.nlm.nih.gov/pubmed/?term=Makris%20N%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)2, [Toschi N](https://www.ncbi.nlm.nih.gov/pubmed/?term=Toschi%20N%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)6, [Barbieri R](https://www.ncbi.nlm.nih.gov/pubmed/?term=Barbieri%20R%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)7, [Napadow V](https://www.ncbi.nlm.nih.gov/pubmed/?term=Napadow%20V%5BAuthor%5D&cauthor=true&cauthor_uid=30803865)8. [↑](#endnote-ref-4)
5. [Trends Mol Med.](https://www.ncbi.nlm.nih.gov/pubmed/29162418) 2017 Dec;23(12):1103-1120. doi: 10.1016/j.molmed.2017.10.006. Epub 2017 Nov 20.

   **Nerve Stimulation: Immunomodulation and Control of Inflammation.**

   [Ulloa L](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ulloa%20L%5BAuthor%5D&cauthor=true&cauthor_uid=29162418)1, [Quiroz-Gonzalez S](https://www.ncbi.nlm.nih.gov/pubmed/?term=Quiroz-Gonzalez%20S%5BAuthor%5D&cauthor=true&cauthor_uid=29162418)2, [Torres-Rosas R](https://www.ncbi.nlm.nih.gov/pubmed/?term=Torres-Rosas%20R%5BAuthor%5D&cauthor=true&cauthor_uid=29162418)3. [↑](#endnote-ref-5)