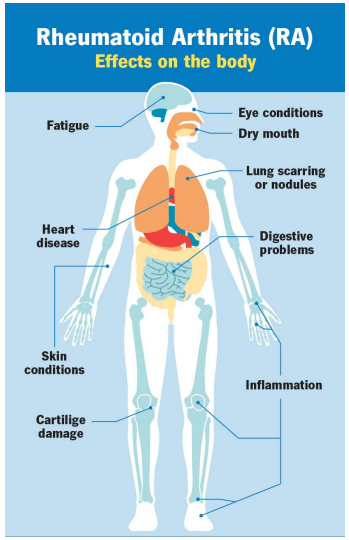
# Autonomic Nervous System Balance in Patients with Rheumatoid Arthritis

Katelyn Williamson, BS[1], Kristina Nagai, DO[2], Peter Allegre, BS[1], Belinda McCully, PhD[1], Jonathan Jones, MD[3]

[1]Western University of Health Sciences, COMP-NW, Lebanon, OR
[2]Samaritan Health Services, Dept. of Internal Medicine, Corvallis, OR
[3]Samaritan Health Services, Dept. of Rheumatology, Corvallis, OR

## INTRODUCTION

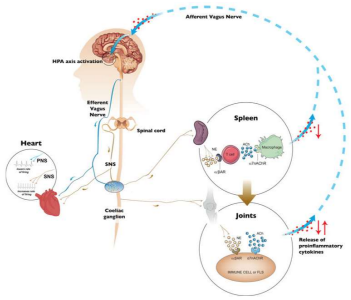
Rheumatoid Arthritis (RA) is a chronic autoimmune inflammatory condition causing joint pain and stiffness. Untreated RA can lead to loss of physical function and the inability to perform daily living activities as well as health risks associated with higher rates of uncontrolled inflammation. The autonomic nervous system (ANS) plays a role in inflammation and pain.




Sympathetic Nervous System (SNS) activity enhances inflammation in the body while Parasympathetic Nervous System (PNS) activity suppresses inflammation in the body. The SNS and PNS normally have a balance which is required for homeostasis. Loss of this balance can lead to disease. Prior data imply that some RA patients can enhance ANS balance with vagal nerve stimulation.

## HYPOTHESIS

We hypothesized that ANS balance has an impact on RA disease activity, and that biopsychosocial factors contribute to ANS balance at baseline and ANS response to non-invasive vagal nerve stimulation (NIVaNS).



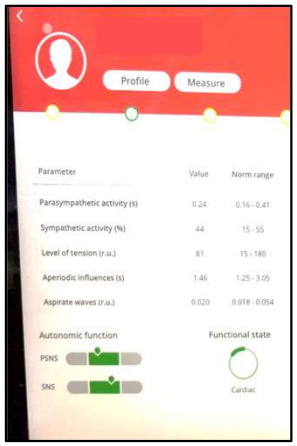

## METHODS

Patients with RA had disease activity assessed using the Clinical Disease Activity Index (CDAI).

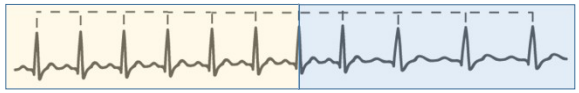
Patients completed questionnaires relating to sleep, post-traumatic stress disorder (PTSD), perceived stress, social connectedness, and exercise. Resting electrocardiogram (EKG) was recorded, by which heart rate variability (HRV) parameters were extracted to assess baseline parasympathetic and sympathetic nervous system activity.

HRV was assessed again following 5 minutes of NIVaNS using a modified Valsalva breathing maneuver. In some patients, HRV analysis was repeated once per month for three months.

Percent SNS and percent PNS change were calculated using the SNS and PNS baseline numbers and the SNS and PNS values that were calculated during the NIVaNS breathing.




**Resting electrocardiogram (ECG)**



(5 seconds) Inhale → ↑HR (10 seconds) Valsalva → ↓HR

## RESULTS

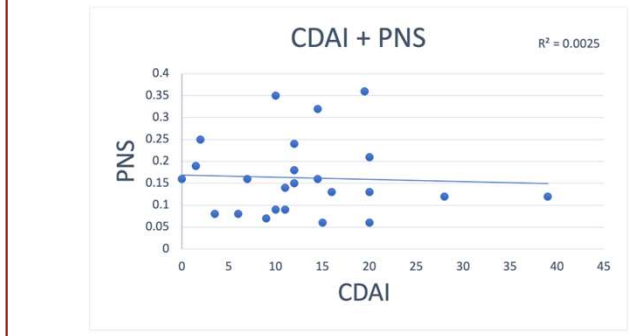



**Figure 1:** Baseline PNS activity did not correlate with RA disease activity.

## RESULTS

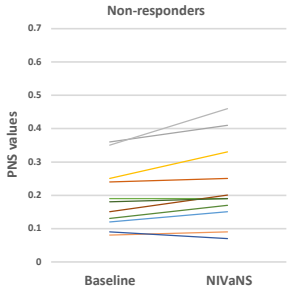



**Figure 2:** NIVaNS intervention resulted in < 50% increase in PNS in 11/24 (46%) patients.

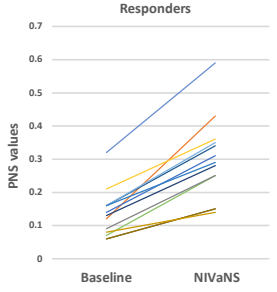



**Figure 3:** NIVaNS intervention resulted in a > 50% increase in PNS in 13/24 (54%)patients.

- At baseline, 54% of patients had low parasympathetic activity, persisting in 58% across all visits.
- PNS change with NIVaNS intervention had no or weak correlation to several biopsychosocial measures including sleep, PTSD, perceived stress, social connectedness, or exercise.

## CONCLUSION

- Patients with > 1 visit had relatively stable PNS values over several months.
- Roughly 50% of RA patients have low baseline PNS activity, however this does not appear to be driven by RA disease activity.
- Surprisingly, the several biopsychosocial factors we evaluated did not differentiate RA patients with low vs. normal baseline PNS, or those that did or did not respond to vagal nerve stimulation.
- Further testing can include more patients or daily at home NIVaNS breathing to evaluate change in PNS levels over time.

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