Autonomic Dysregulation, Interoception, and Self-Regulation: Biofeedback Applications for Dysautonomia

Anna Hayburn, PsyD

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Cleveland Clinic

Every life deserves world class care.

Materials that are included in this course may include interventions and modalities that are beyond the authorized practice of mental health professionals. As a licensed professional, you are responsible for reviewing the scope of practice, including activities that are defined in law as beyond the boundaries of practice in accordance with and in compliance with your profession’s standards.

No financial disclosures to report.

Objectives

- Summarize the psychophysiological mechanisms of autonomic dysfunction, a review of related dysautonomia conditions, and common management strategies.
- Provide a rationale for the use of HRV, sEMG, and thermal biofeedback as non-pharmacological treatment approaches for managing autonomic dysfunction.
- Review common findings and unique treatment considerations for the use of biofeedback for people with dysautonomia.

What is Dysautonomia?

A heterogeneous group of conditions characterized by impaired autonomic regulation:

- orthostatic dizziness/lightheadedness
- altered heart rate
- activity intolerance
- fatigue/insomnia
- cognitive dysfunction
- pain
- digestive problems
- temperature dysregulation
- anxiety

(Blitshteyn, 2025)

What is POTS?

Postural Orthostatic Tachycardia Syndrome

A heart rate increase of 30 beats per minute or more, within the first 10 minutes of standing, in the absence of orthostatic hypotension

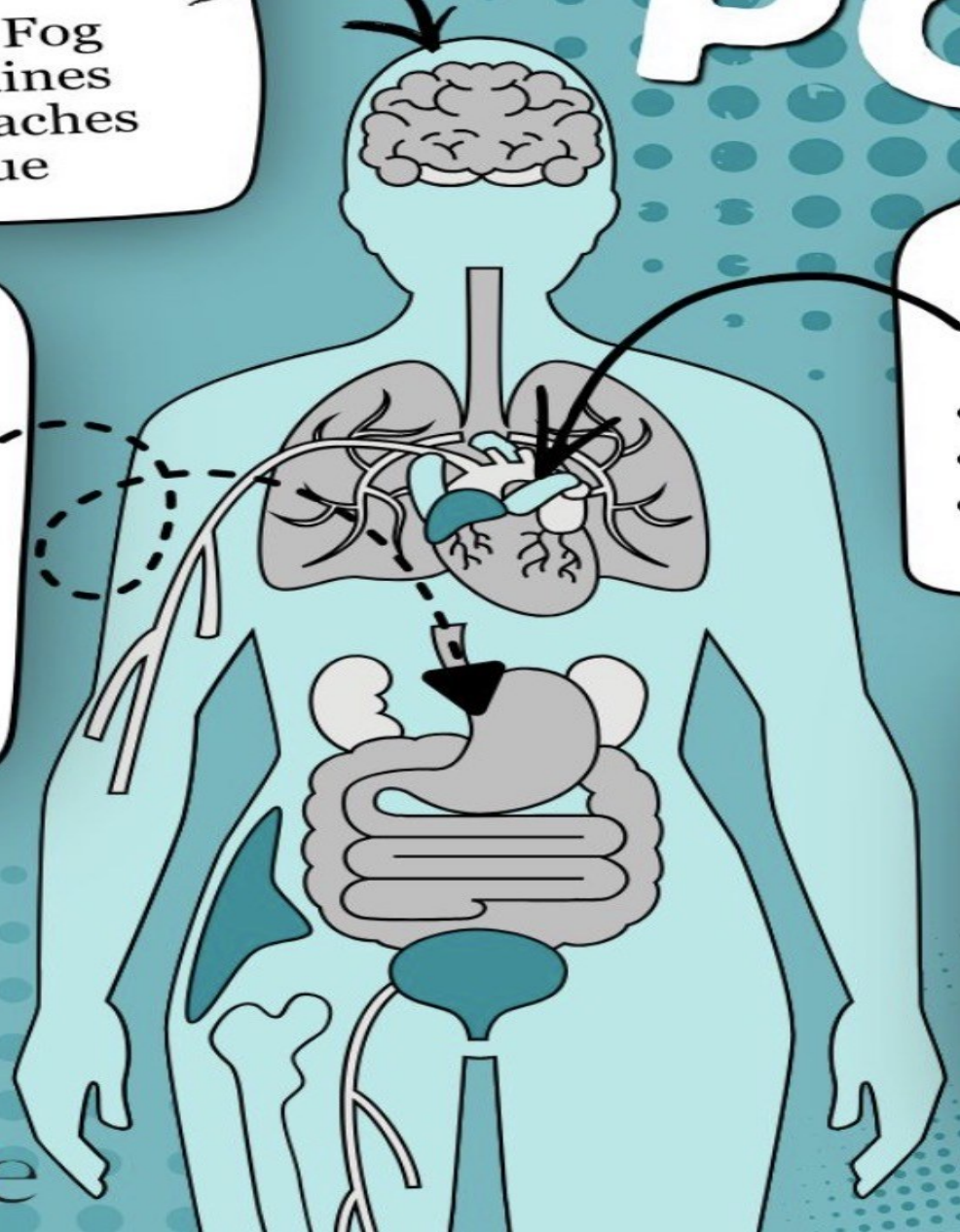
Symptoms of POTS

Neurological Symptoms:

- Brain Fog
- Migraines
- Headaches
- Fatigue

Stomach and Digestive Symptoms:

- Bloating
- Abdominal Pain and Discomfort
- Constipation
- Diarrhea
- Nausea



Heart and Circulation Symptoms

- Tachycardia
- Chest Pain
- Dizziness

- Tiredness and Weakness
- Temperature Regulation Problems
- Bladder Issues
- Excessive Sweating
- Vision Changes

THE POTS life

Variations of Dysautonomia

- POTS: Postural Orthostatic Tachycardia Syndrome
- Orthostatic Hypotension / Hypertension
- Orthostatic intolerance
- Inappropriate Sinus Tachycardia
- Vasovagal Syncope
- Autoimmune Autonomic Ganglionopathy
- Multiple System Atrophy

Why Do People Get Dysautonomia/POTS?

*this is only a partial list

- Autoimmune Conditions (e.g., Sjogren's Syndrome, lupus, Rheumatoid Arthritis)
- Viral illness or other infection
  - long COVID, mono, Lyme Disease, Epstein Barr
- Traumatic Brain Injury
- Ehlers Danlos Syndrome (hypermobility)
- Mast Cell Activation Syndrome
- Chiari malformation (cerebellum puts pressure onto spinal cord)
- Vitamin Deficiencies (B12 common), anemia
- TRAUMA (emotional or medical such as pregnancy or a surgery)

Pathophysiology
(varies)

- Structural or neurodegenerative damage to autonomic pathways
- Hypovolemia (reduced blood volume) and circulatory abnormalities (e.g., impaired vasoconstriction when standing)
- Hypermobile connective tissue laxity causes vascular dysfunction
- Hyperadrenergic (excess sympathetic nervous system activity)
- Baroreflex dysfunction impacts blood pressure regulation
- Vasovagal response

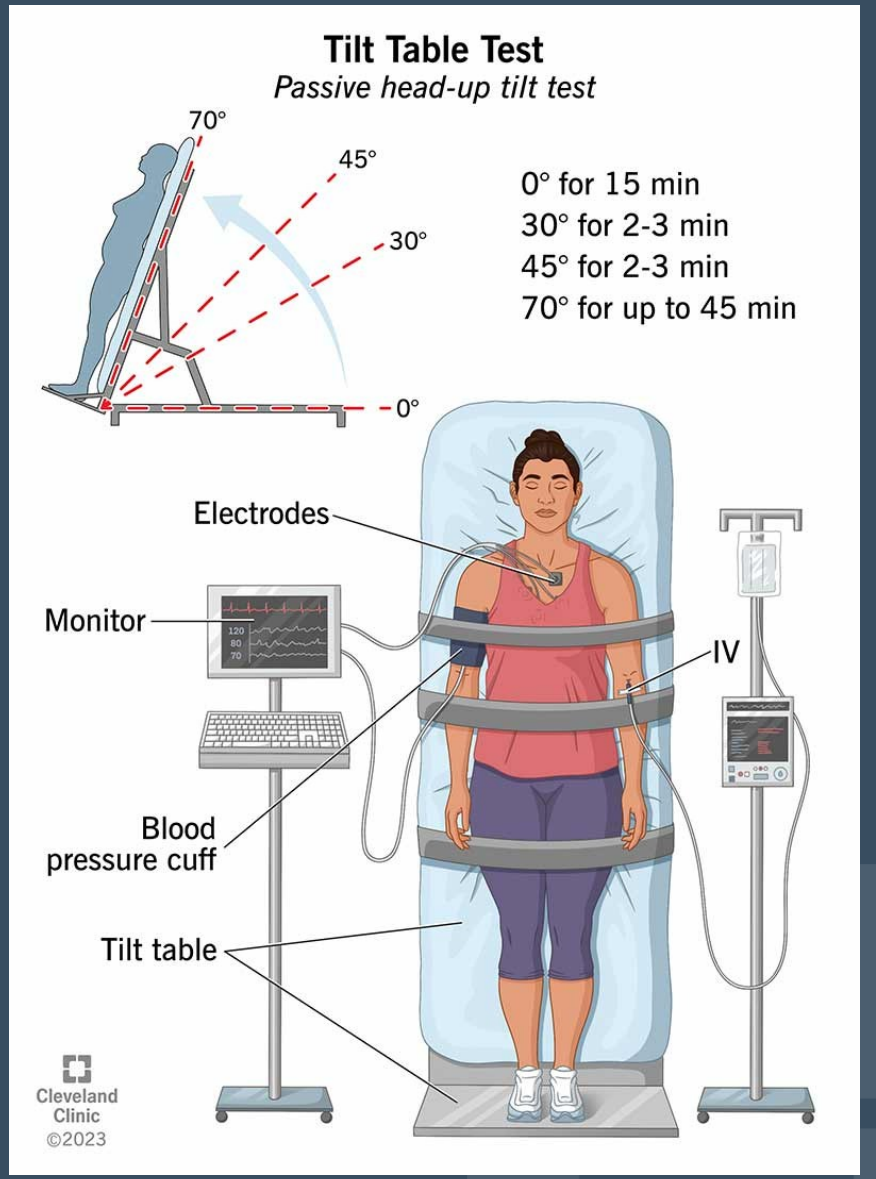
Prevalence

- An estimated 70 million people live with dysautonomia (Dysautonomia International)
- This figure has likely increased since the COVID-19 pandemic as 30-40% of people who experience a COVID-19 infection develop some form of long-COVID (Hou et al., 2025)
- High variability regarding symptomatic presentations and level of functional impairment

DIAGNOSING

- TILT TABLE TEST: measures your heart rate and blood pressure as you change posture and position

- QSART: measures the autonomic nerves that control sweating
- Nerve biopsy: test for neuropathy



Common Challenges

- Showering
- Warm environments
- Standing for long periods
- Exercise / strenuous activity
- Driving
- Insomnia
- Adrenaline rushes
- Hormone dysregulation
- Longer recovery when sick or procedures
- Executive dysfunction/brain fog

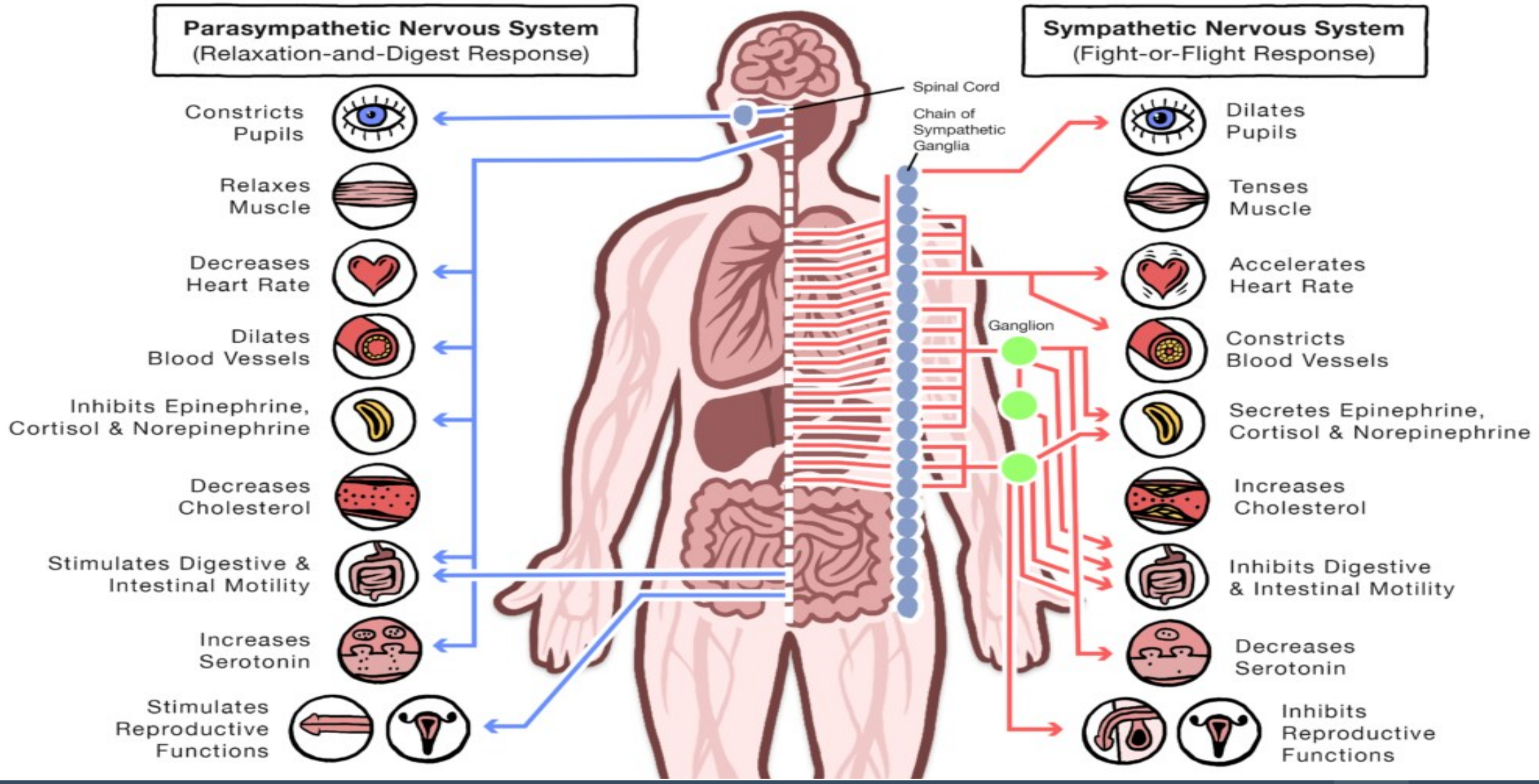
Medication Considerations

- Beta Blockers (e.g., propranolol) – control/reduce heart rate
- Ivabradine - reduces heart rate without affecting vascular tone
- Midodrine – constricts blood vessels to reduce blood pooling, increases blood pressure
- Fludrocortisone (Florinef) – increases blood volume
- Pyridostigmine (mestinon) – prevents increase in HR, helpful for various POTS sx
- Benzodiazepines (e.g., Klonopin, Ativan) – counteract adrenaline, manage anxiety
- SSRIs, SNRIs for anxiety/depression

Lifestyle Adaptations

- Increase hydration = 3L daily (12 cups, 100 oz)
- Increase salt intake (varies per person, 3-8g?)
  - Electrolytes, add salt to food, salty snacks
- Wear compression
  - knee-high socks, leggings, or abdominal binder
- Smaller meals/snacking throughout the day
- Elevate head during sleep (wedge pillow)
- Cardiac rehab
- Likely sensitive to caffeine and alcohol

AUTONOMIC NERVOUS SYSTEM



- Autonomic dysfunction can contribute to: (Chen et al., 2021)
  - heightened interoceptive awareness
  - visceral hypersensitivity
  - increased bodily vigilance

- Biofeedback approaches can help this population to better understand and influence their body's responses to achieve:
  - improved autonomic regulation, self regulation
  - symptom management
  - greater interoceptive balance / interoceptive reappraisal
  - resilience when living with an often-disabling chronic condition

BIOFEEDBACK APPLICATIONS FOR DYSAUTONOMIA:

HRV

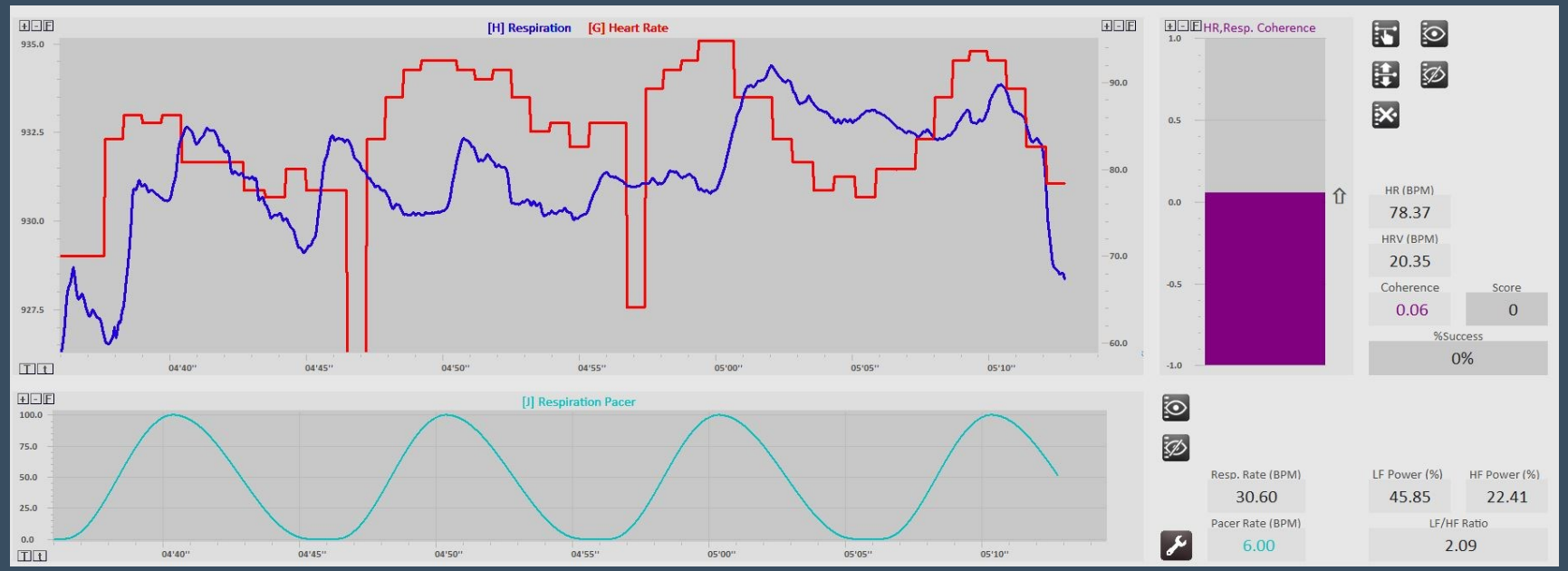
sEMG

THERMAL

Heart Rate Variability (HRV) Biofeedback Applications

- In healthy autonomic function, HRV is flexible and responsive. In many people with dysautonomia, HRV is reduced or poorly regulated.
- Typical for this population to experience “over-breathing” or “air hunger” (quicker, more shallow breath count; 15-20 breaths per min range)
- HRV biofeedback strengthens parasympathetic (vagal) activity, which is often underactive in dysautonomia. This can help counter excessive sympathetic activation.

- Breathing with diaphragm engagement should be the default, unless in an active/exertional state (parasympathetic activation = diaphragmatic breathing).
  - Goal to improve breathing awareness and directing breath to diaphragm, as well as development of deep diaphragmatic breathing for regulation.


[H] Respiration
[G] Heart Rate
935.0
932.5
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[J] Respiration Pacer
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75.0
50.0
25.0
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HR,Resp. Coherence
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-1.0
HR (BPM)
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HRV (BPM)
20.35
Coherence
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Score
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Resp. Rate (BPM)
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LF Power (%)
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HF Power (%)
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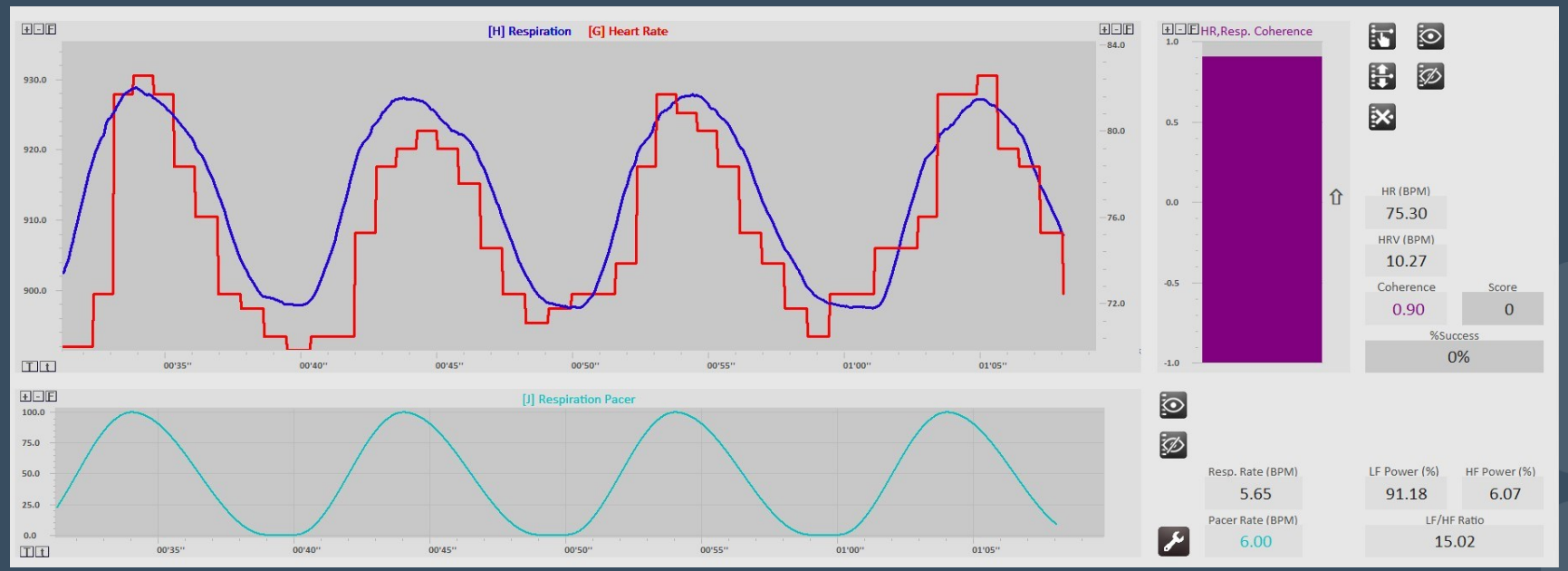
LF/HF Ratio
2.09


[H] Respiration
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[J] Respiration Pacer
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HR,Resp. Coherence
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HR (BPM)
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HRV (BPM)
10.27
Coherence
0.90
Score
0
%Success
0%
Resp. Rate (BPM)
5.65
Pacer Rate (BPM)
6.00
LF Power (%)
91.18
HF Power (%)
6.07
LF/HF Ratio
15.02

HRV Biofeedback

- Diaphragmatic breathing for dysautonomia:
  - Adapted (quicker) breath count of 7 (3 second inhale / 3 second exhale)
  - apply 10 times
  - use when physiological symptoms are occurring, when anxious, and when trying to go to sleep (all situations where dysregulation may be present)

HRV: Common Findings

- Re-train proper muscle engagement for diaphragmatic breathing
  - Pelvic floor dysfunction is common in this population, consider referral to PFPT
- Practicing while lying down is usually easiest (greater muscle control), then apply while sitting and standing
- Use hands on diaphragm as tactile cue to guide where breath should go

HRV: Common Findings

- Paradoxical response
  - common for this population to initially experience an exacerbation of their dysautonomia symptoms
    (e.g., orthostatic intolerance, tachycardia, paresthesia)
  - This can offer insight re: autonomic and respiratory dynamics and interoceptive dysfunction, NOT a sign of treatment failure
- Impact on feasibility and follow through with interventions
- Consider practical / simple ways for application

(Wareing et al., 2024)

HRV: Common Findings

When feeling sensations such as lightheadedness that can worsen anxiety, try to lean in to the discomfort.

Reasoning for symptoms is due to the significant difference in breathing style, change in carbon dioxide levels. It should dissipate with continued practice.

Use your breath to ground yourself, notice your diaphragm and other muscles engaged in breathing.

HRV: Common Findings

- Stress response in the moment and abdominal muscle deconditioning may be contributing to lower coherence despite ability to slow the breath and engage diaphragm

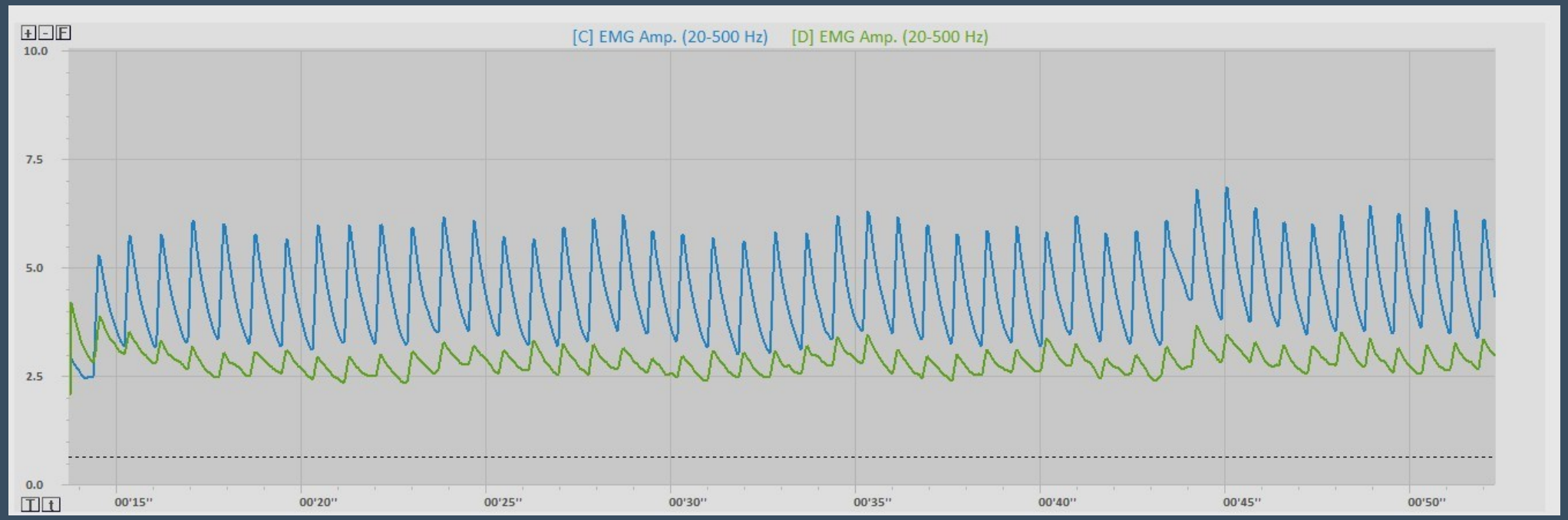
sEMG Biofeedback: Common Findings

- “Coat hanger” pain – stiffness/aching in the upper back, neck, and shoulders due to reduced blood flow and build up of lactic acid
  - Incorporate upper body stretches, shoulder rolls

- For people with hypermobility/EDS – when applying Progressive Muscle Relaxation for targeted area, they often evidence residual tension (continued muscle engagement after activity)
  - may be better to focus on relaxation/release component vs activation of the muscles

sEMG Biofeedback Applications

- Strategies for internal relaxation to release tension buildup
  - invoke a sense of heaviness/weightedness in the limbs
  - Incorporate diaphragmatic breathing
  - awareness of posture
- Encourage incorporating throughout the day as a way to "reset“
- If unable to achieve meaningful tension reduction during session, consider the following referrals:
  - Medical massage
  - Osteopathic manipulation therapy
  - Physical therapy
  - Medical interventions (e.g., trial of muscle relaxer)


[C] EMG Amp. (20-500 Hz)
[D] EMG Amp. (20-500 Hz)
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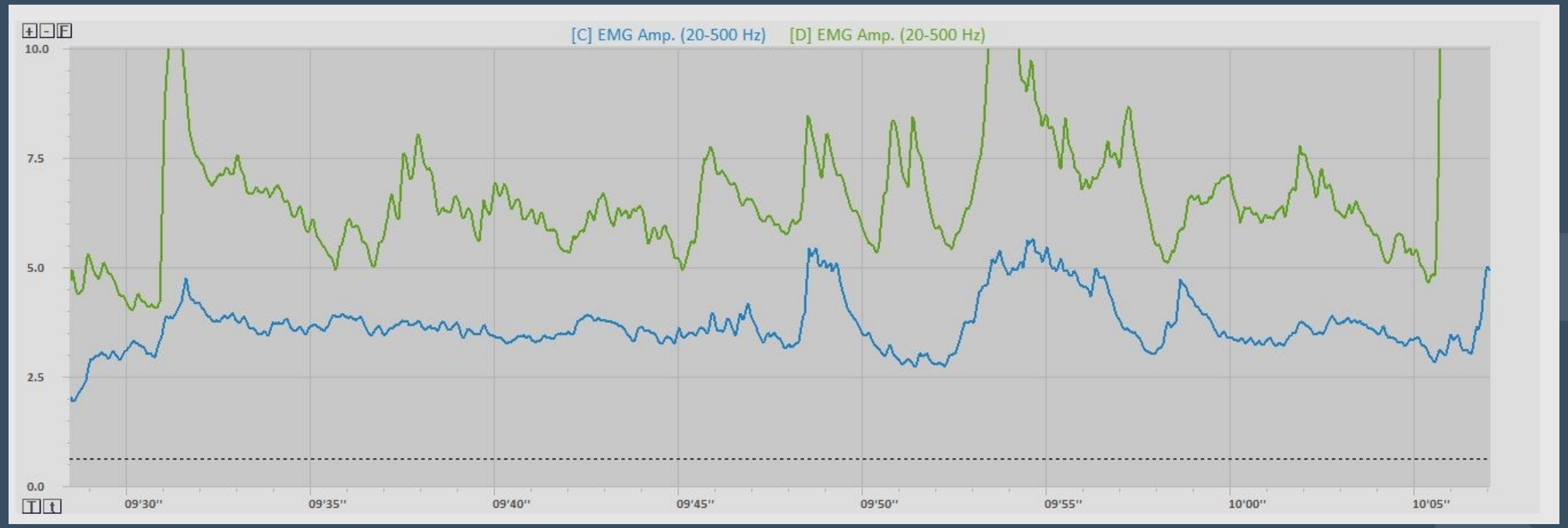
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09'55''
10'00''
10'05''

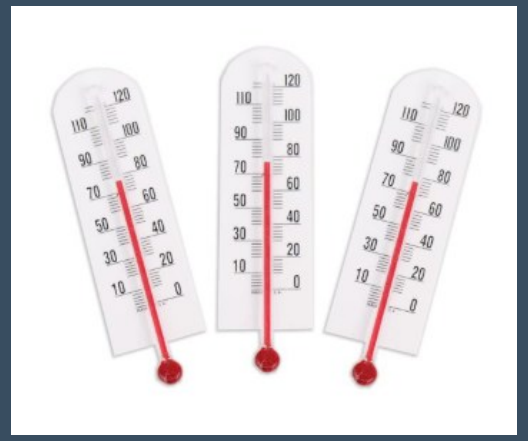
Thermal Biofeedback Applications

- migraines, Raynaud's Syndrome, temperature dysregulation, stress response

- Many people with dysautonomia have abnormal vasoconstriction/vasodilation
  - Training to intentionally dilate blood vessels
  - Improve vascular control

Thermal Biofeedback Applications

- Encourages parasympathetic activation
- Be mindful of trauma history, a paradoxical response to relaxation can occur
- Consider providing a thermistor to support practice



Resources/Support for Patients with Dysautonomia

Standing Up To POTS®

Dysautonomia International

AWARENESS ADVOCACY ADVANCEMENT

THE POTSCAST

Dysautonomia Support Network

References

- Blitshteyn S. (2025). Dysautonomia: a common comorbidity of systemic disease. *Immunologic research*, *73*(1), 105. https://doi.org/10.1007/s12026-025-09661-2

- Chen, W. G., Schloesser, D., Arensdorf, A. M., Simmons, J. M., Cui, C., Valentino, R., Gnadt, J. W., Nielsen, L., Hillaire-Clarke, C. S., Spruance, V., Horowitz, T. S., Vallejo, Y. F., & Langevin, H. M. (2021). The Emerging Science of Interoception: Sensing, Integrating, Interpreting, and Regulating Signals within the Self. *Trends in neurosciences*, *44*(1), 3–16. https://doi.org/10.1016/j.tins.2020.10.007

- Hou, Y., Gu, T., Ni, Z., Shi, X., Ranney, M. L., & Mukherjee, B. (2025). Global Prevalence of Long COVID, Its Subtypes, and Risk Factors: An Updated Systematic Review and Meta-analysis. *Open forum infectious diseases*, *12*(9), ofaf533. https://doi.org/10.1093/ofid/ofaf533

- Wareing, L., Readman, M. R., Longo, M. R., Linkenauger, S. A., & Crawford, T. J. (2024). The Utility of Heartrate and Heartrate Variability Biofeedback for the Improvement of Interoception across Behavioural, Physiological and Neural Outcome Measures: A Systematic Review. *Brain Sciences*, *14*(6), 579. https://doi.org/10.3390/brainsci14060579