Orthostatic Intolerance in Adolescents:

A Practical Approach to Postural Tachycardia Syndrome (POTS)

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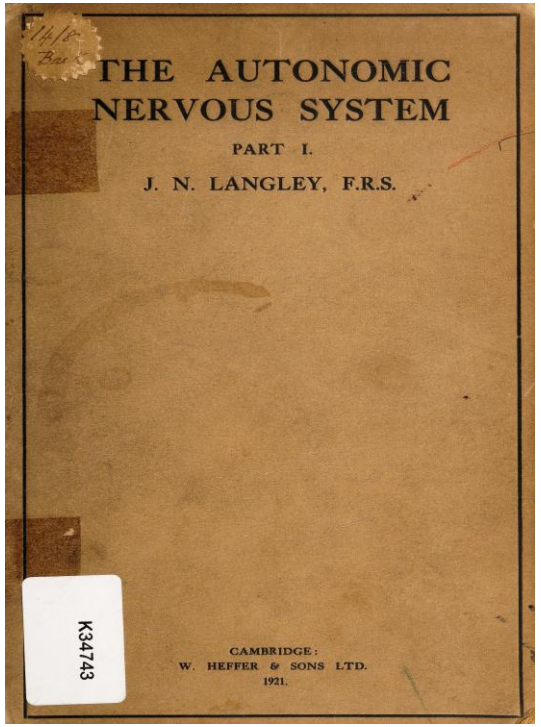
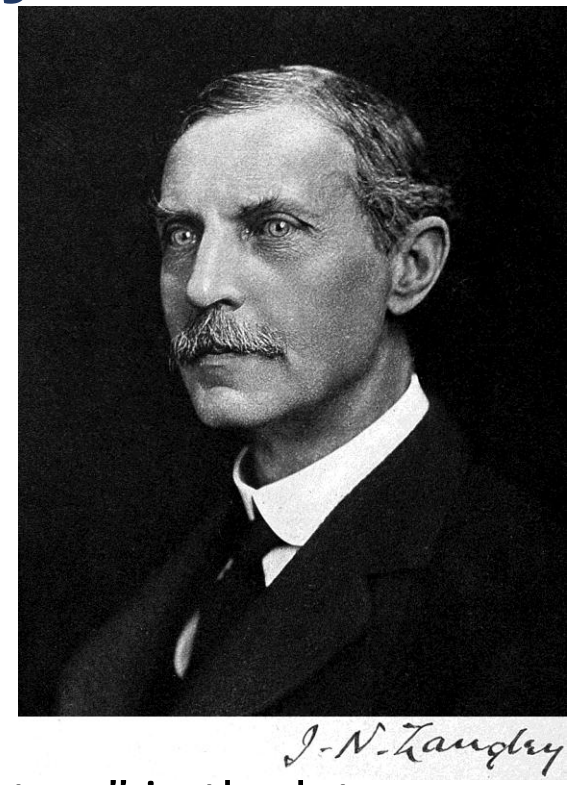
Overview

- Neuroanatomy (including historical framework)
- Key definitions and diagnostic criteria
- Structured clinical approach
- Evaluation (history, exam, orthostatic vitals)
- Clinical neurophysiology principles
- Treatment (non-pharmacologic and pharmacologic)

Origins of the Autonomic Nervous System

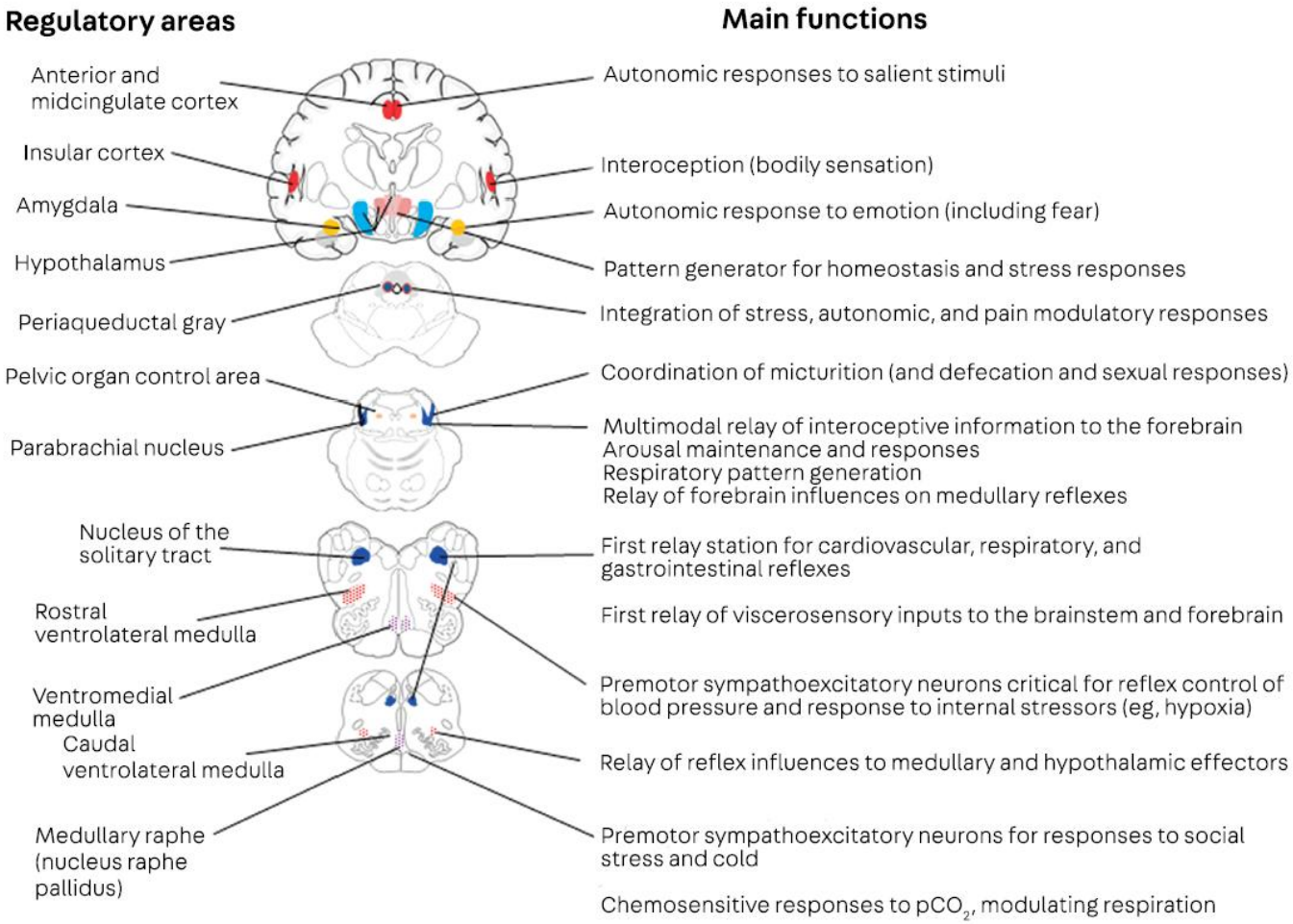


John Newport Langley
English physiologist



- introduced the concept and terminology of the “autonomic nervous system” in the late 1890s (commonly cited as 1898).
- described networks of nerves outside the central nervous system arising from peripheral ganglia
- conceptualized the autonomic nervous system as **sympathetic** and **parasympathetic**, while recognizing extensive intrinsic neural networks within the gastrointestinal tract.

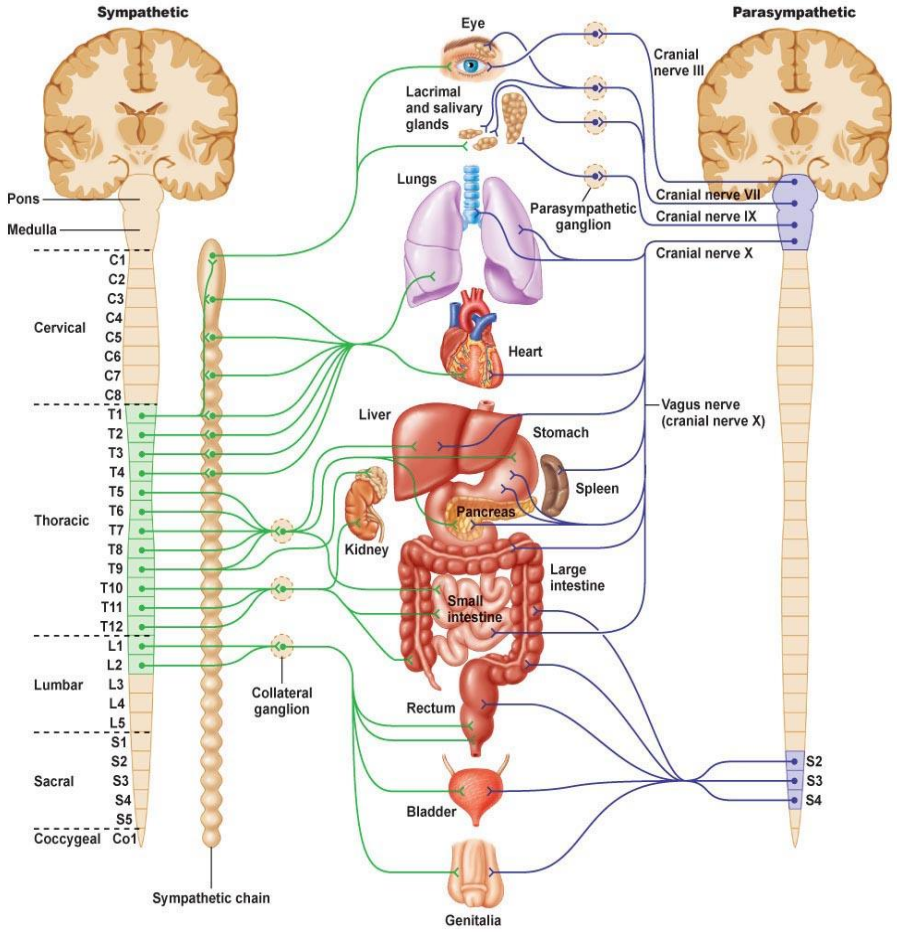
Autonomic Nervous System
Brain and Brainstem Centers



Continuum, AAN 2020

Autonomic Nervous System

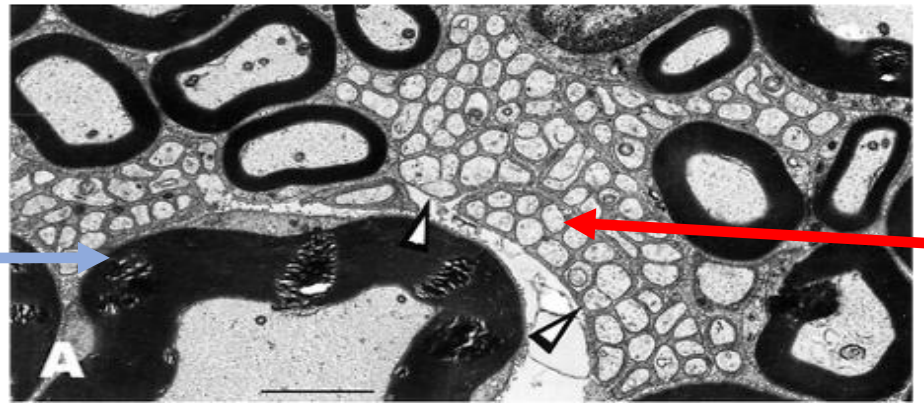
Spinal Cord Centers and Pathways



https://link.springer.com

Autonomic Nervous System

Peripheral Nerve



Large Nerve Fibers 20%

Small Nerve Fibers 80%

Nerve Fiber type	Diameter (μm)	Velocity (m/s)	Function
A-α β	5-20	30-70	Motor, proprioception, touch, pressure
A-γ	3-6	15-30	Muscle spindles
A-δ (Thinly myelinated)	1-5	3-30	Light touch, acute pain and cold temperature
Type B (moderately myelinated)	<3	3-15	Visceral afferent and **preganglionic autonomic efferent**
C (Unmyelinated)	<1	<2	Slow pain and heat , **post-ganglionic autonomic fibers**

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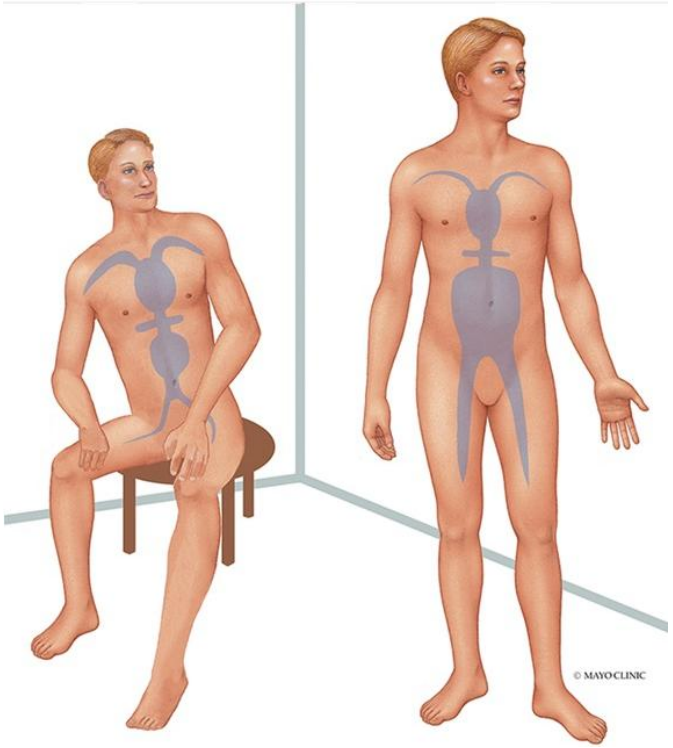
Autonomic Nervous System
Cardiovascular Control

- Upright posture => shift of 300-800 ml of blood from the thorax to below diaphragm & secondary shift of plasma into the interstitial tissue.

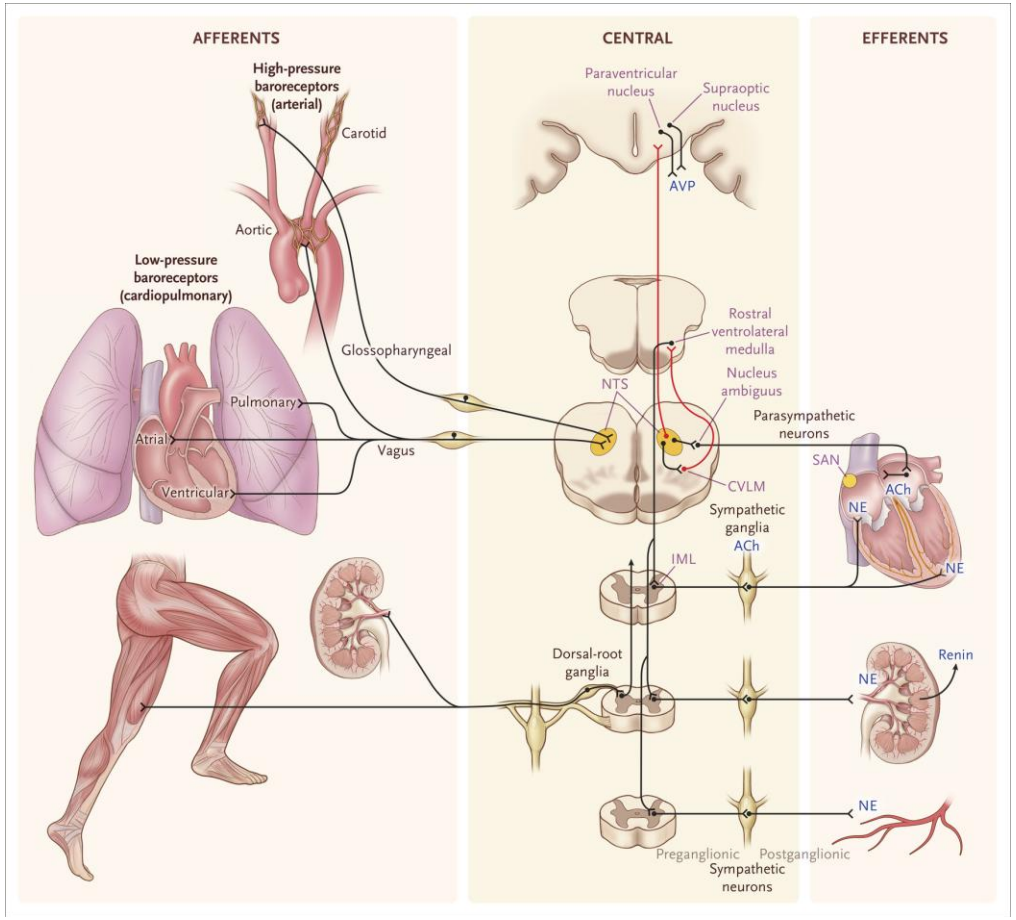
- ↓ preload, results in a ↓in cardiac output and BP. This unloads the baroreceptors and triggers ↓ in parasympathetic and ↑ in sympathetic tone => in ↑ HR and systemic vasoconstriction.

- The net hemodynamic effect of transition to upright posture is a 10-20 beats per minute increase in HR with fall in SBP of 5-10 mmHg.



Autonomic Nervous System
Baroreflex

- Arterial BP is regulated by sympathetic input to skeletal muscle and mesenteric blood vessels driven by neurons in RVLM.
- Baroreflex is the principal mechanism for short term moment-to-moment control of blood pressure.
- Arterial baroreceptors are mechanosensitive nerve endings in the wall of the carotid sinus (CNIX), and aortic arch (CNX). They respond to stretch elicited by pulse pressure.
- Afferent fibers synapse on neurons of the NTS to start a sympatho-inhibitory response that reduces output to the resistance blood vessels through RVLM.
- Neurons of NTS also activate the cardiovagal neurons of the nucleus ambiguous, soliciting bradycardia in response to an increase in BP.



New England Journal of Medicine 2020, Horacio Kaufmann

Approach to Autonomic Disorders
Localize and Search for Cause

- **Brain and Brainstem Pathology:** Neurodegenerative (MSA, PD, LBD), Autoimmune Encephalitis, Stroke, Seizure, Multiple Sclerosis

- **Spinal Cord Pathology:** Syringomyelia, Transverse Myelitis, Traumatic Spinal Cord Injury

- **Peripheral Nerve Pathology:** Autonomic/small fiber Neuropathies (Diabetic and Metabolic, Autoimmune/Paraneoplastic, Post-Infectious, Toxic, Genetic, Nutritional, Amyloidosis), Autonomic Ganglionopathies, Degenerative (PAF)

- **Disorders of Reduced Orthostatic Tolerance:** POTS, Syncope

Autonomic Disorders

Cardiovascular Control

Orthostatic intolerance is inability to tolerate the upright posture due to symptoms and signs of cerebral hypoperfusion, relieved by lying down

- Brain hypoperfusion: dizziness, light-headedness, cognitive slowing
- Retinal and visual pathway hypoperfusion: blurry vision, dimmed vision
- Upper body muscle hypoperfusion: coat hanger pain, headaches
- Lung hypoperfusion (reduced preload): dyspnea, fatigue

Orthostatic intolerance conditions:

- Neurogenic Orthostatic Hypotension (OH)
- Postural Orthostatic Tachycardia Syndrome (POTS)
- Neurally Medicated Syncope (NMS)

Autonomic Disorders
Orthostatic Hypotension

- **Sustained** drop in SBP ↓ ≥20 mmHg or DBP ↓ ≥10 mmHg within 3 mins
- Sign of volume depletion or/and impaired peripheral vascular vasoconstriction
- Common in elderly (reduced intravascular volume, blood pooling-varicose veins, anemia, medicines, physical deconditioning)
- Neurogenic OH: Reduced NE release from post ganglionic sympathetic fibers

  diabetic neuropathy, non-diabetic small fiber and autonomic neuropathy, autonomic ganglionopathies, high spinal cord lesions, neurodegenerative disorders (alpha-synucleinopathies)

- Neurological exam is key to differentiate degenerative forms vs autonomic neuropathy

Autonomic Disorders
Postural Tachycardia Syndrome (POTS)

- **Sustained** HR increase ≥30 bpm (≥40 bpm ages 12–19) within 10 min
- An absence of orthostatic hypotension
- Frequent symptoms of orthostatic intolerance during standing, with rapid improvement upon return to a supine position
- Duration of symptoms for at least 3 months
- Absence of other conditions explaining sinus tachycardia

  anorexia nervosa, primary anxiety disorders, hyperventilation, anemia, fever, pain, infection, dehydration, hyperthyroidism, pheochromocytoma, use of cardioactive drugs (e.g. sympathomimetics, anticholinergics) or severe deconditioning

Autonomic Disorders
Neurally Mediated Syncope

- Sudden ↓ HR (cardioinhibitory – bradycardia/asystole) or no change (vasodepressor)
- Sudden BP drop
- Systolic/diastolic BP < 60/40 mmHg

Syndrome of inappropriate sinus tachycardia (IST)

- Elevated heart rate not influenced by postural changes
- A persistent, non-paroxysmal elevation in resting heart rate (>100 beats/min at rest) and elevated 24-hour mean heart rate (>90 beats/min) that is not influenced by postural changes
- Unlike POTS, elevated heart rates during rest, supine activity, and sleep, with symptoms including palpitations, lightheadedness, chest discomfort, and exercise intolerance.
- Increased intrinsic sinus node automaticity (demonstrated by elevated intrinsic heart rate after autonomic blockade), sympathetic predominance, parasympathetic withdrawal, and genetic abnormalities in pacemaker ion channels such as gain-of-function HCN4 mutations

POTS as a defined clinical syndrome

Applying the orthostatic intolerance framework to POTS

Case presentation

- A 16-year-old competitive gymnast presents with a 6-month history of dizziness, palpitations, and fatigue. Symptoms are most pronounced with standing, during prolonged practices, and after routines requiring rapid position changes. She reports near-syncope on the balance beam but no true loss of consciousness. She also endorses headaches with photophobia, difficulty concentrating in school, and worsening symptoms in hot environments.
- Her symptoms began several weeks after a viral illness and progressed during a period of increased training intensity. She denies chest pain, exertional dyspnea, or disordered eating. Menstrual cycles have become irregular over the past year.

Case presentation

- A 21-year-old competitive soccer player presents with persistent dizziness, headaches, and exercise intolerance 8 weeks after a concussion sustained during a head-to-head collision while attempting a header. She did not lose consciousness but experienced immediate headache, dizziness, and visual blurring. Initial symptoms improved over the following two weeks; however, she has been unable to return to full practices.
- She now reports daily lightheadedness upon standing, palpitations, nausea, and worsening headaches during conditioning drills and prolonged standing on the sidelines. Symptoms are exacerbated by heat and dehydration. She also endorses difficulty concentrating in school, fatigue, and increased sensitivity to light and noise.

Epidemiology

- One of the most common disorders of the autonomic nervous system
- Estimated prevalence of 0.1%–1%
- Usually affects adolescent girls and young adult women

Comorbid conditions with POTS

- Migraine headaches
- Hypermobile Ehlers-Danlos syndrome (hEDS) and hypermobile spectrum disorders (HSD)
- Myalgic-encephalomyelitis/chronic fatigue syndrome
- Fibromyalgia
- Autoimmune disorders
- Mast cell activation disorder (MCAS)
- Celiac disease
- Concussion
- Anxiety

JIM Journal of Internal Medicine
Founded in 1863

Original Article | Open Access

The face of postural tachycardia syndrome – insights from a large cross-sectional online community-based survey

B. H. Shaw, L. E. Stiles, K. Bourne, E. A. Green, C. A. Shibao, L. E. Okamoto, E. M. Garland, A. Gamboa, A. Diedrich, V. Raj, R. S. Sheldon, I. Biaggioni, D. Robertson, S. R. Raj

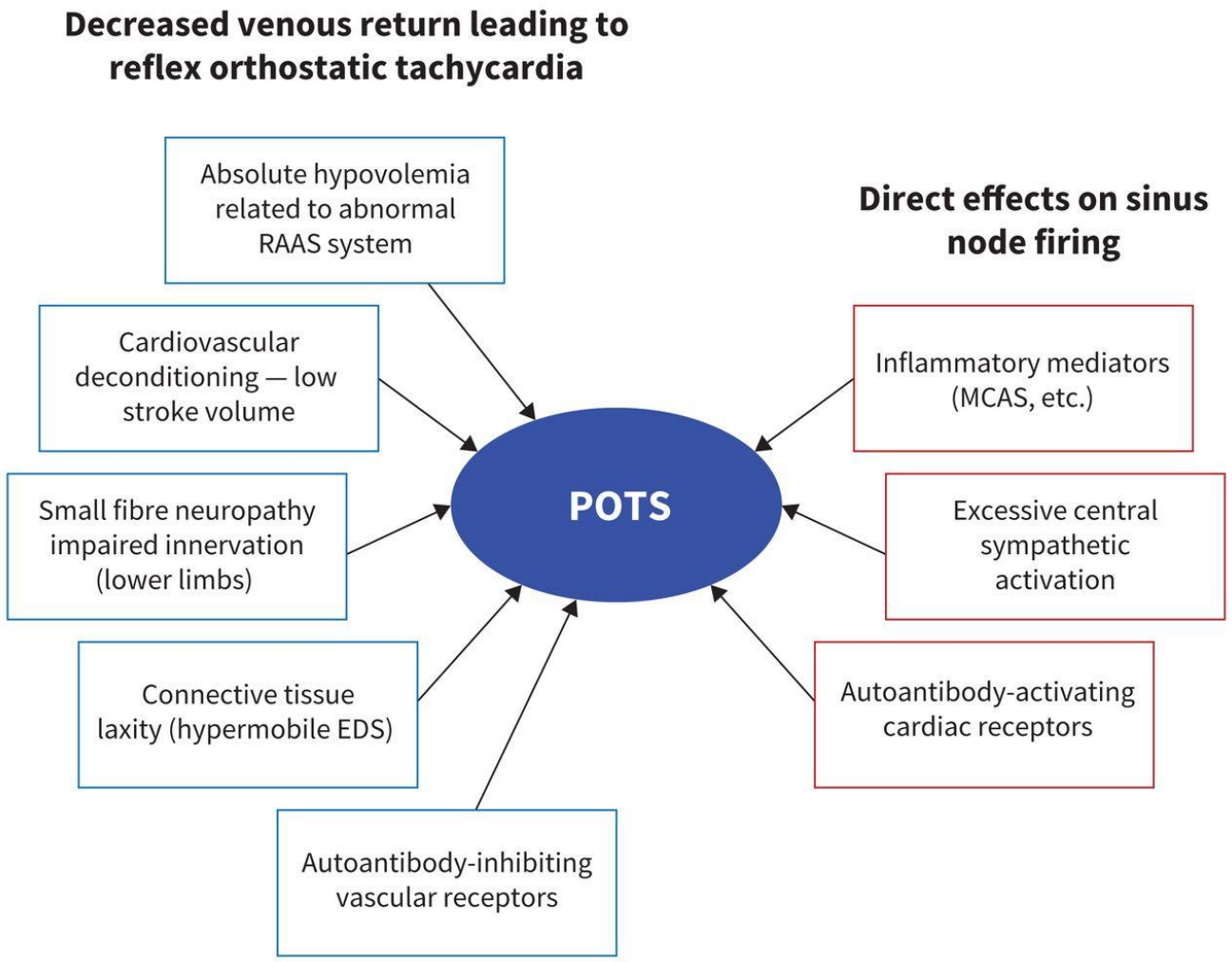
First published: 12 March 2019 | https://doi.org/10.1111/joim.12895 | VIEW METRICS

Proposed pathophysiological mechanisms for postural orthostatic tachycardia syndrome (POTS).

Hypovolemic

Neuropathic

Hyperadrenergic



Satish R. Raj et al. CMAJ 2022;194:E378-E385

How should patients be evaluated for POTS?

Step 1

- Targeted symptom history,
- Potential triggers and precipitating events,
- Current and prior medications (including recent changes),
- Factors that can improve or worsen symptoms,
- Patient’s ability to exercise,
- Patient’s quality of life

Autonomic Review of Systems

Lightheadedness, dizziness, syncope or presyncope with standing
Headache or head pressure worsening in the upright position
Palpitations, tachycardia, chest discomfort, shortness of breath or exercise intolerance
Fatigue, brain fog, visual dimming or blurred vision
Abnormal sweating, acrocyanosis, or dependent venous pooling
Tremulousness, heat intolerance, cold extremities, or temperature dysregulation
Dry eyes, dry mouth
Photophobia, difficulty focusing with eyes
Nausea, abdominal pain, bloating, diarrhea, constipation, or urinary symptoms
Neck and shoulder pain (“coat-hanger” pain)
Sleep disturbance, non-restorative sleep, or post-exertional symptom worsening

Step 2

Identification of high-risk clinical contexts

- Adolescents and young adults
- History of hypermobility or Ehlers-Danlos syndrome
- Post concussion
- Recent viral illness or long COVID
- Deconditioning or prolonged inactivity
- Comorbid functional or multisystem symptoms

Step 3

Adjunctive use of standardized instruments to quantify symptom burden

- MAPS (self-assessment of symptom burden 0-10 of 12 symptoms)
- Cardiac symptoms (palpitations, dizziness, presyncope, dyspnoea and chest pain)
- Non-cardiac symptoms (gastrointestinal symptoms, insomnia, concentration difficulties, headache, myalgia, nausea and fatigue)
- During the previous 7 days


JIM Original Article

doi: 10.1111/joim.13566

Malmö POTS symptom score: Assessing symptom burden in postural orthostatic tachycardia syndrome

Jasmina Medic Spahic[1,2], Viktor Hamrefors[1,3], Madeleine Johansson[1,2], Fabrizio Ricci[1,4], Olle Melander[1,3], Richard Sutton[1,5] & Artur Fedorowski[1,6,7]

Step 4

Orthostatic vital signs

① Have the patient lie down for 5 minutes.

② Measure blood pressure and pulse rate.

③ Have the patient stand.

④ Repeat blood pressure and pulse rate measurements after standing 1 and 3 minutes.

POSITION	TIME	BP	ASSOCIATED SYMPTOMS
Lying Down 	5 Mins.	BP____/_____ HR_____	
Standing 	1 Min.	BP____/_____ HR_____	
Standing 	3 Mins.	BP____/_____ HR_____	

Centers for Disease Control and Prevention
National Center for Injury Prevention and Control

- 1, 3, 5, 8, 10 minutes

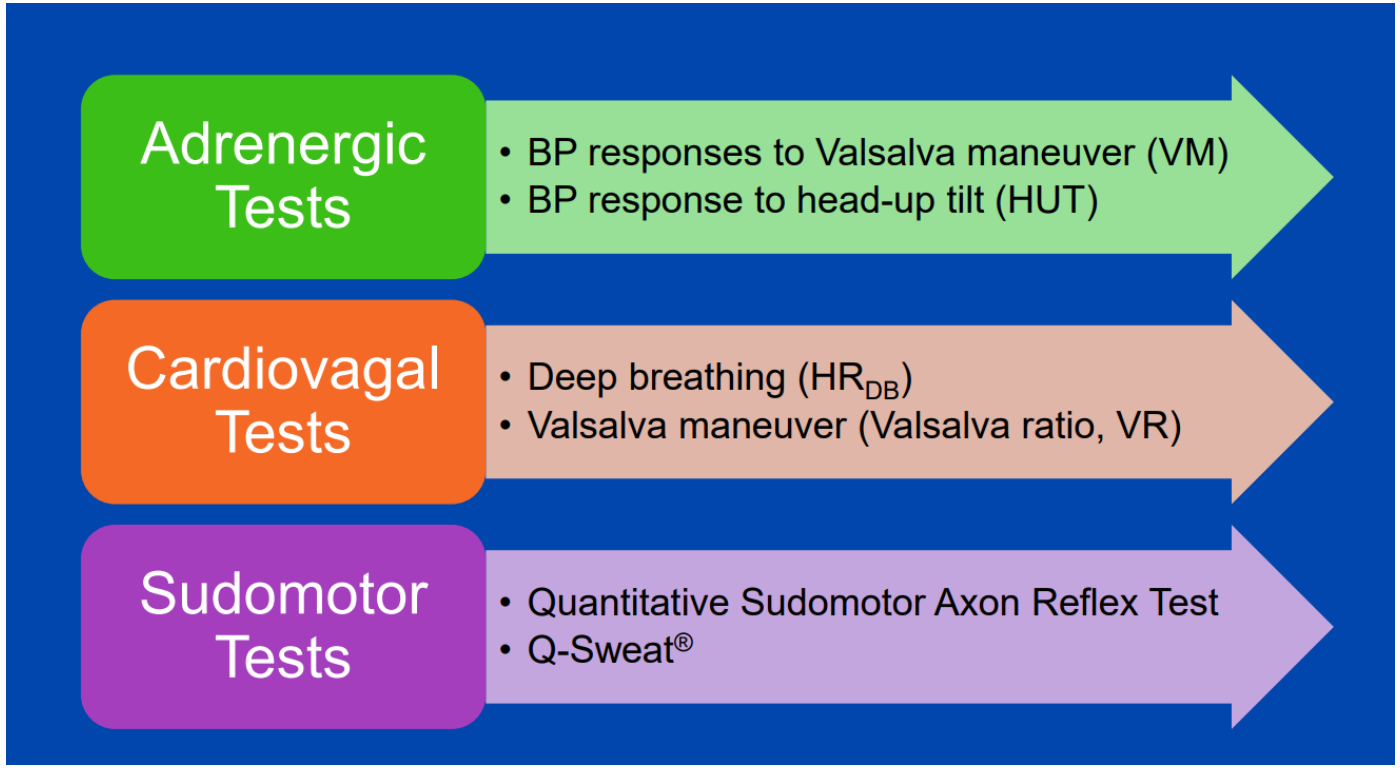
- Excessive orthostatic tachycardia, a sustained heart rate increase of at least 30 beats/min (for adults) or at least 40 beats/min (for patients aged 12–19 yr) on at least 2 of the readings taken when standing

Examination

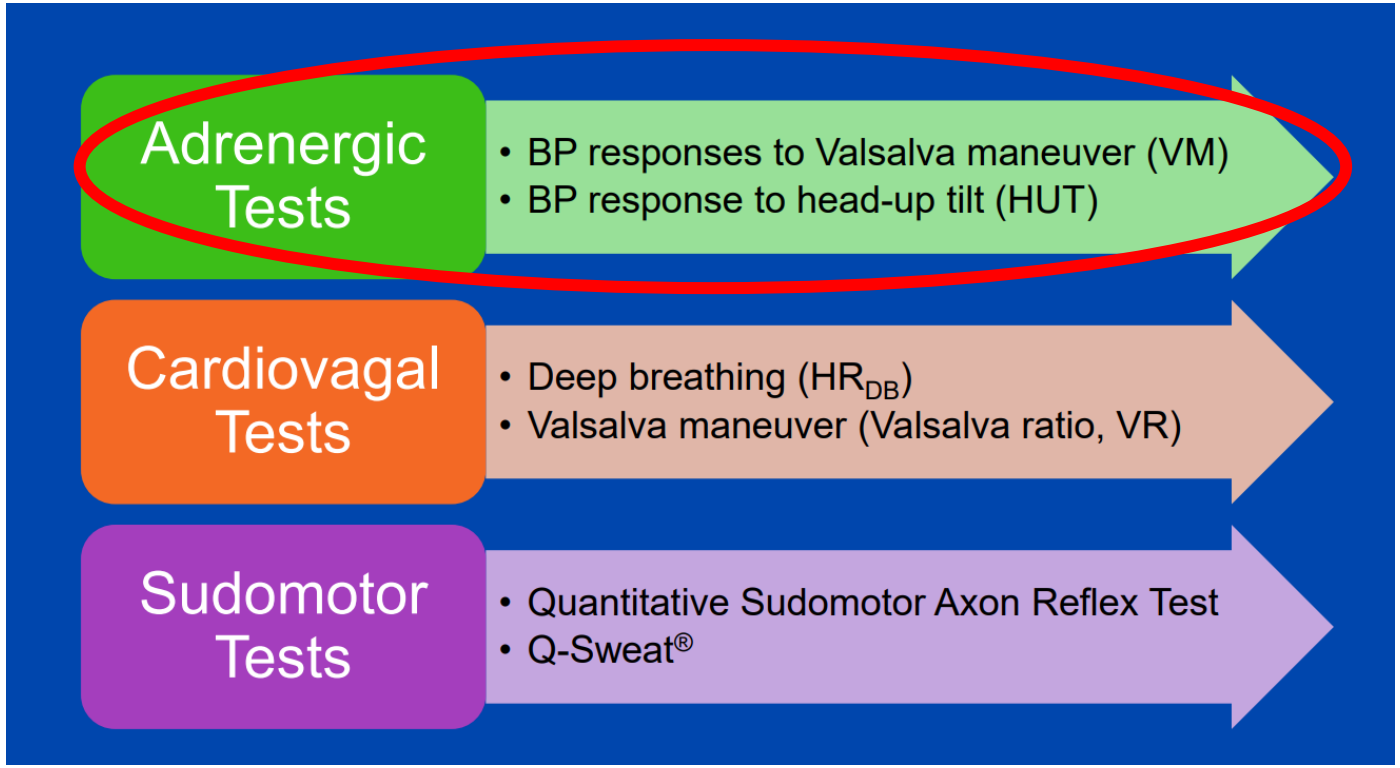
- **Ambulation:** Unsteady gait, use of wheelchair or walker
- **Skin Changes:** Discoloration, skin mottling, piloerection, distal hair loss, dystrophic skin changes
- **Sensory Loss:** In patients with associated small fiber neuropathy (length vs non-length dependent)
- **Mucosal Changes:** Dry and red eyes, dry mouth
- **Pupillary Changes:** Abnormal pupillary size and response to light (pinpoint, dilated, sluggish light response)
- **Presence of Feeding Tube**

Autonomic Reflex Testing

Clinical neurophysiology principles (Autonomic Reflex Screen)

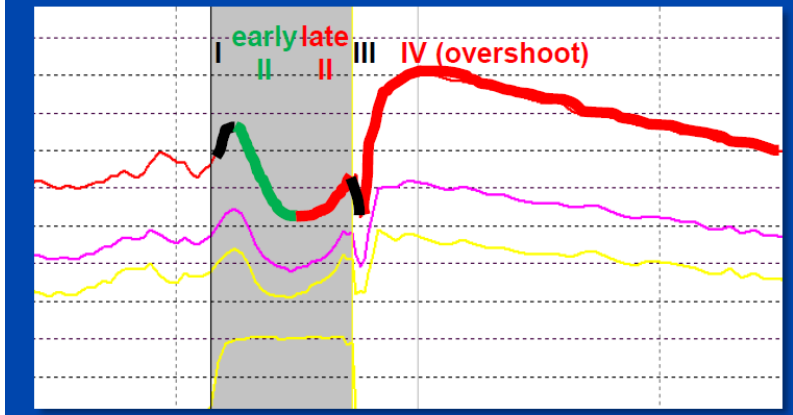


Clinical neurophysiology principles



Autonomic Reflex Screen (Valsalva)

Valsalva Maneuver

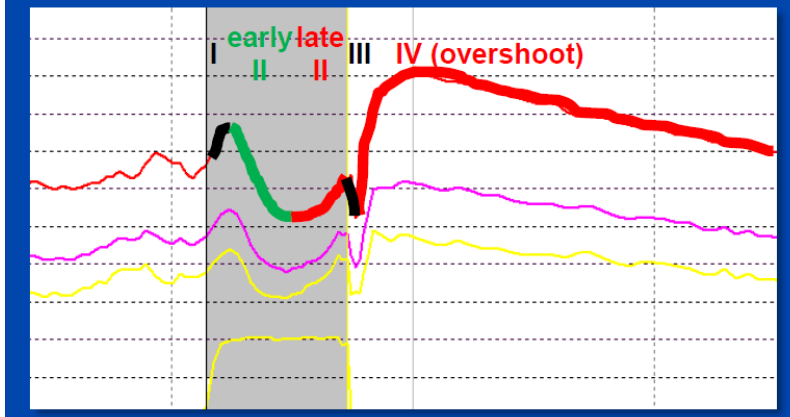


normal BP response to Valsalva

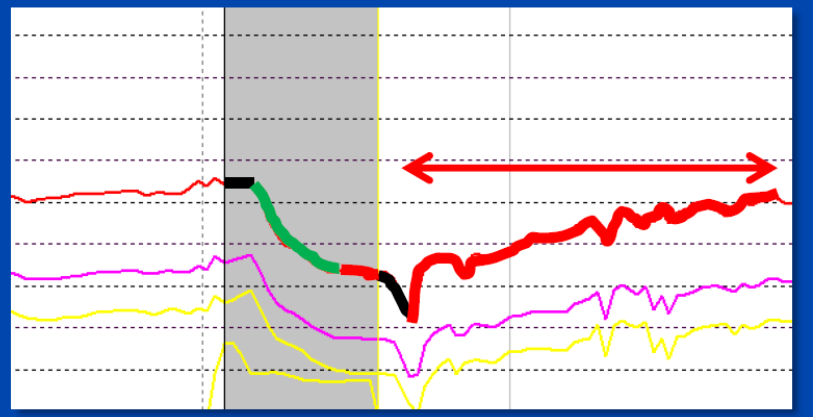
Phase	BP response (mechanism)	HR response (mechanism)
I	↑ (mechanical vascular compression)	none / ↓ (straining)
early II	↓ (reduced cardiac output)	↑ (cardiovagal withdrawal due to baroreceptor unloading)
late II	recovery (reflex sympathetic vasoconstriction)	further ↑ (sympathetic activation)
III	transient ↓ (mechanical decompression)	remains ↑
IV	overshoot (increased stroke volume, persistent vasoconstriction)	↓ (baroreflex-triggered cardiovagal activation)

Autonomic Reflex Screen (Valsalva)

Valsalva Maneuver



normal BP response to Valsalva



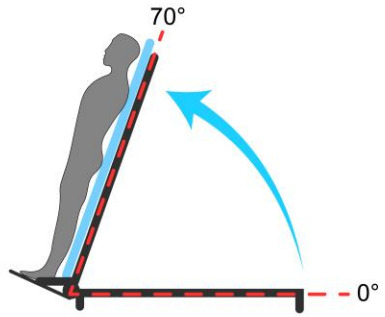
absent late phase II, absent phase IV, and prolonged pressure recovery time → cardiovascular adrenergic failure

Autonomic Laboratories
Wentworth Douglass Hospital (Pease)
Mass General Hospital
Brigham and Women's Faulkner Hospital

A Stepwise Approach to the Head-Up Tilt Table Test

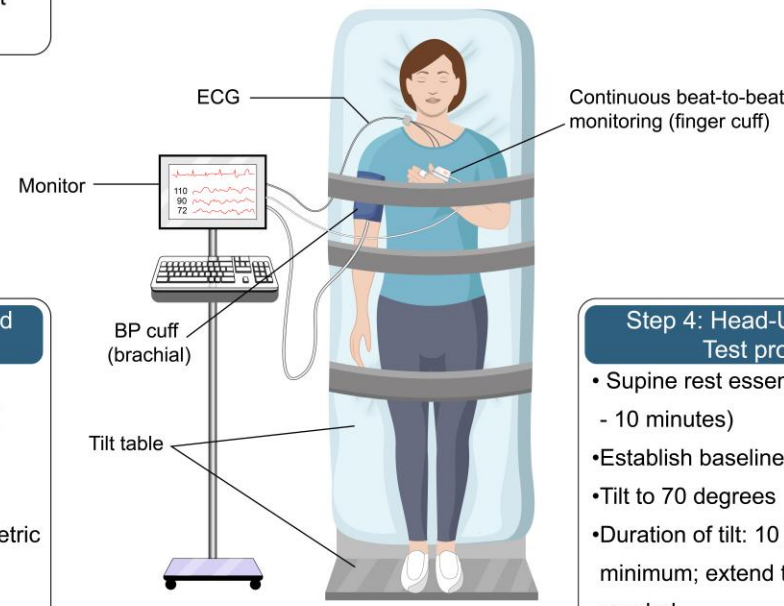
Step 1: Preparation for test

- No caffeine, nicotine, food for at least 3 hours before test
- Avoid alcohol on the day of test
- Hold cardioactive medicines for at least 5 half-lives before test (eg. sympatholytics, vasodilators, anticholinergics)
- If medicines continued, consider autonomic effects and interpret cautiously



Step 2: Autonomic laboratory equipment

- Motorized tilt table ideal (smooth, controlled)
- Rapid tilt capability (transition duration <10 seconds)
- Armrest; arm extended and abducted at heart level
- Safety features - manual override, footrest and secure safety belts



Step 3: Heart rate and blood pressure processing

- Three-lead ECG monitoring
- Continuous beat-to-beat blood pressure monitoring critical (noninvasive; finger cuff)
- Calibrated against an oscillometric brachial cuff
- Plot the systolic, mean and diastolic blood pressure (BP) simultaneously with heart rate (HR)
- Consider cerebral blood flow monitoring, capnography or catecholamine levels

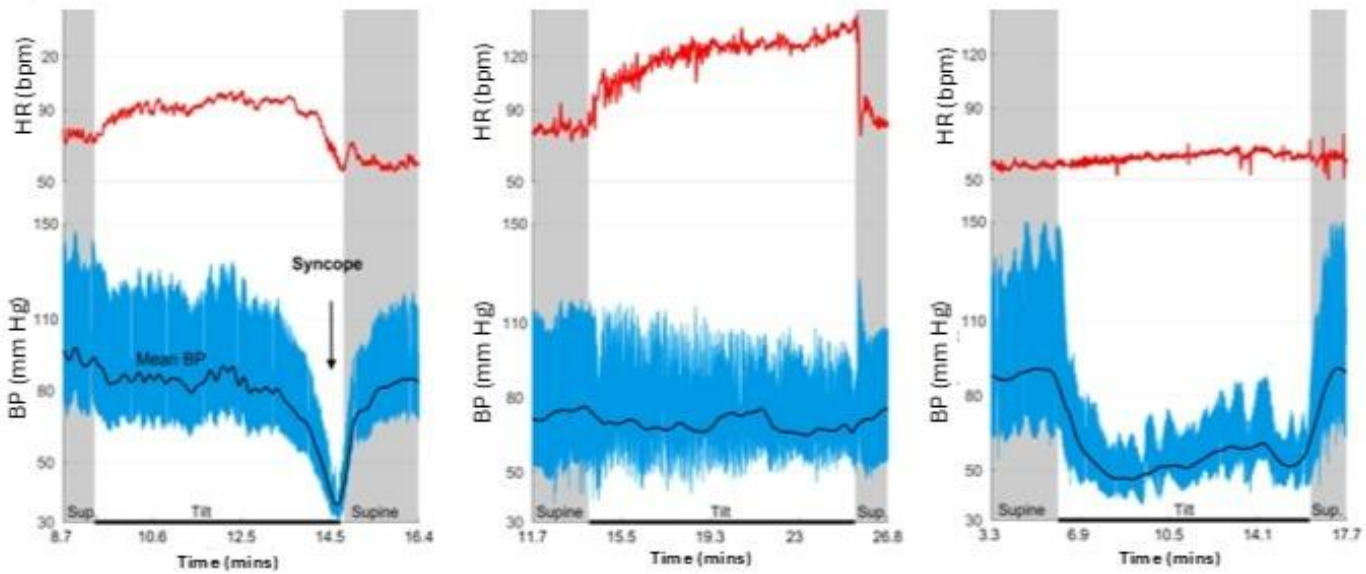
Step 4: Head-Up Tilt Table Test protocol

- Supine rest essential before tilt (5 - 10 minutes)
- Establish baseline BP/HR
- Tilt to 70 degrees
- Duration of tilt: 10 minutes minimum; extend to 40 minutes if needed

Key Diagnostic Criteria: NMS vs POTS vs OH

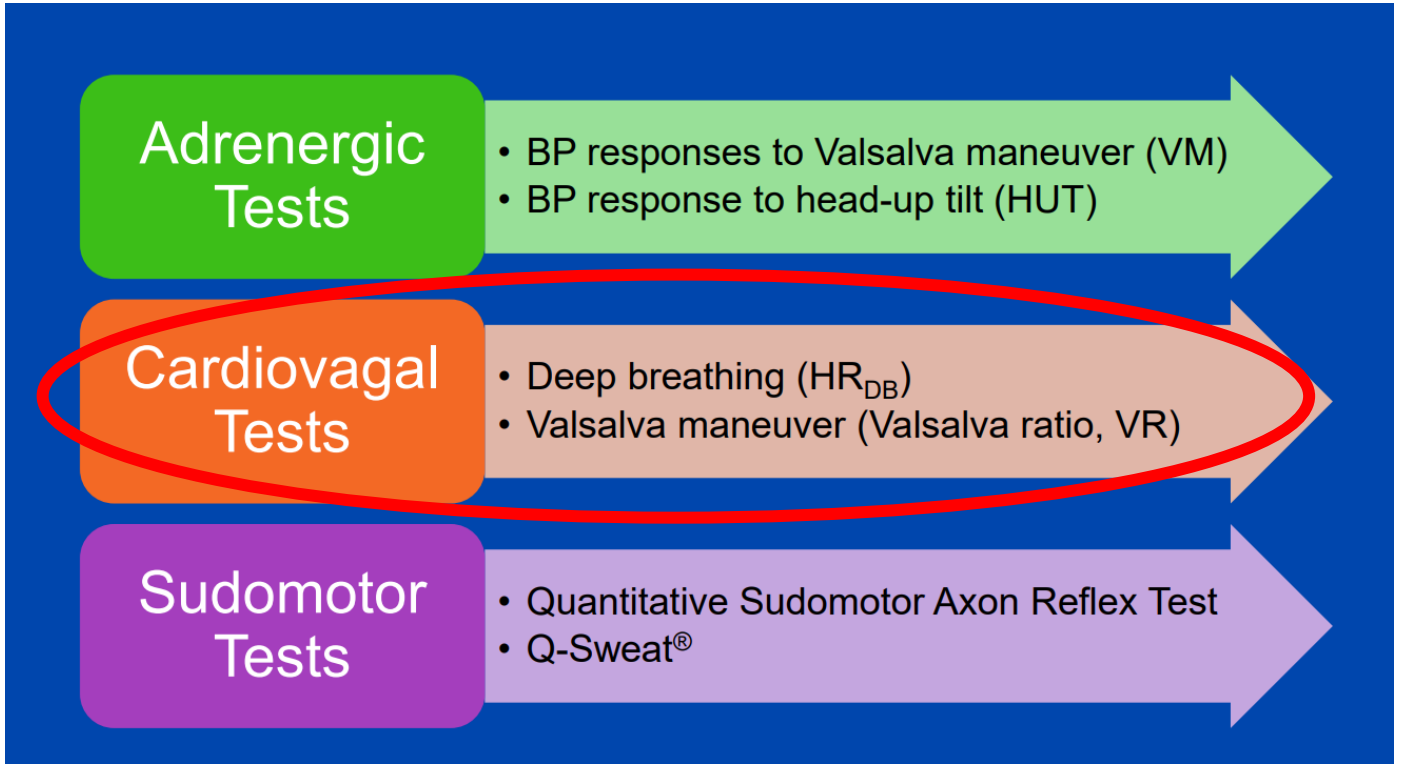
Feature	Neurally Mediated Syncope (NMS)	Postural Orthostatic Tachycardia Syndrome (POTS)	Neurogenic Orthostatic Hypotension (OH)
Heart rate	Sudden ↓ HR (cardioinhibition – bradycardia/asystole) or no change (vasodepressor)	Sustained HR increase ≥30 bpm (≥40 bpm ages 12–19) within 10 min	Inadequate compensatory HR increase
Blood pressure	Sudden BP drop	No orthostatic hypotension	Sustained BP drop
BP criteria	Typically systolic/diastolic BP < 60/40 mmHg	BP stable or increased	SBP ↓ ≥20 mmHg or DBP ↓ ≥10 mmHg within 3 mins

Cardiovascular profile during the head-up tilt table test

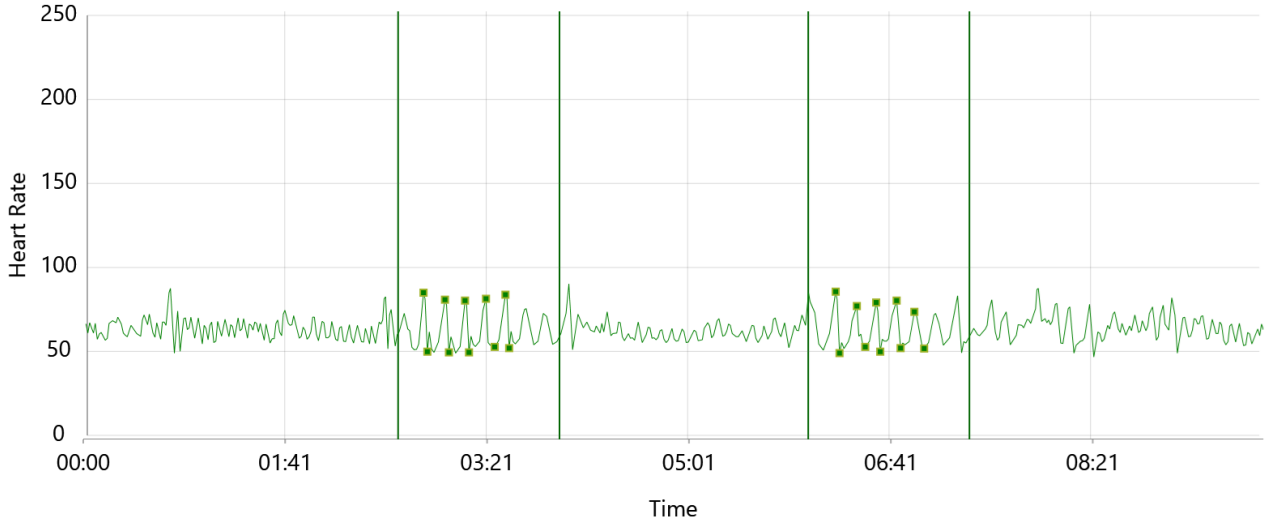


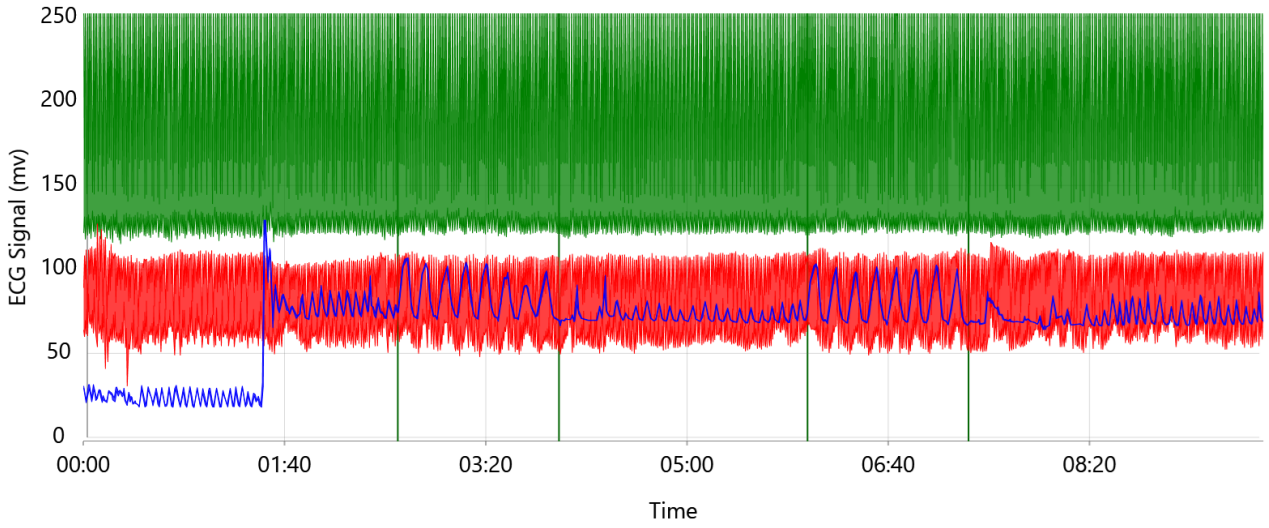
Dysautonomia Diagnosis

Autonomic Reflex Screen (Cardiovagal Tests)

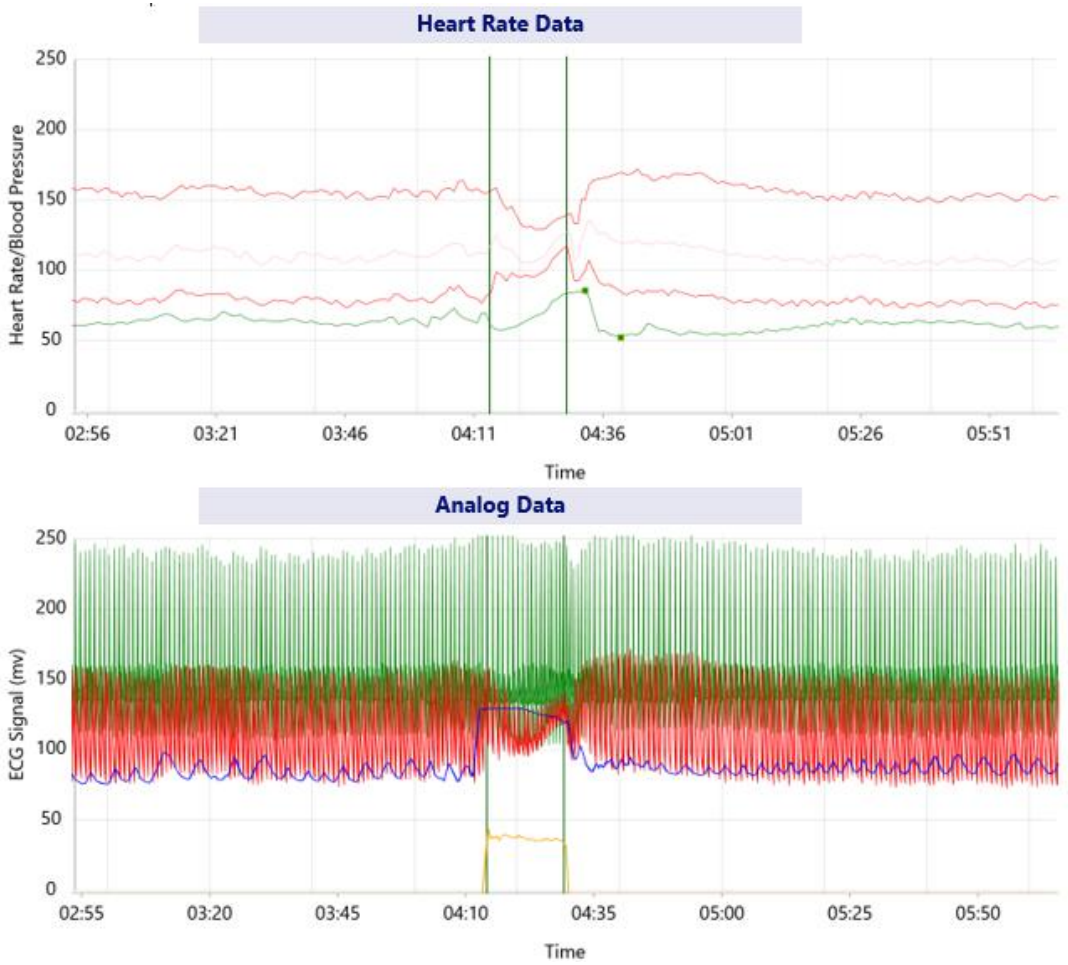


Heart Rate Variability To Deep Breathing



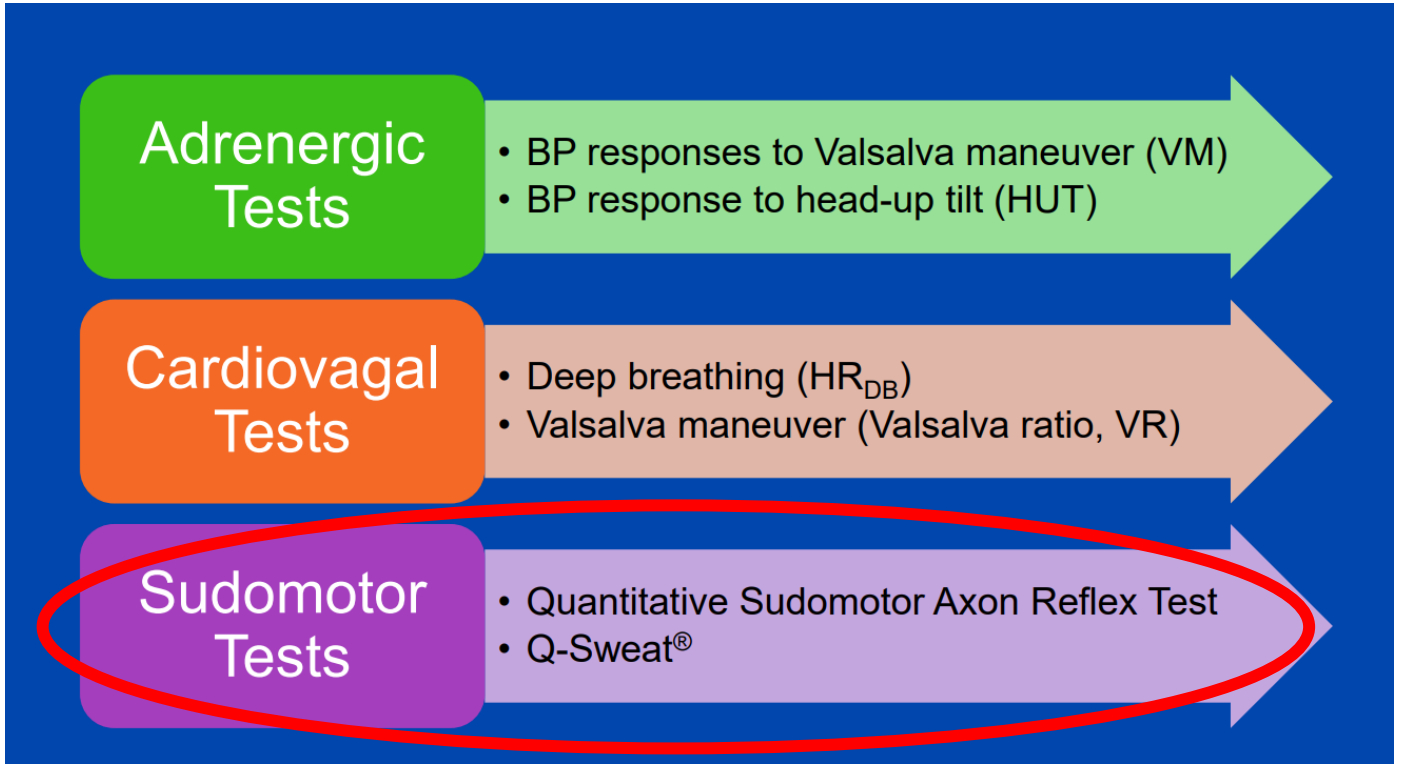


Valsalva Ratio

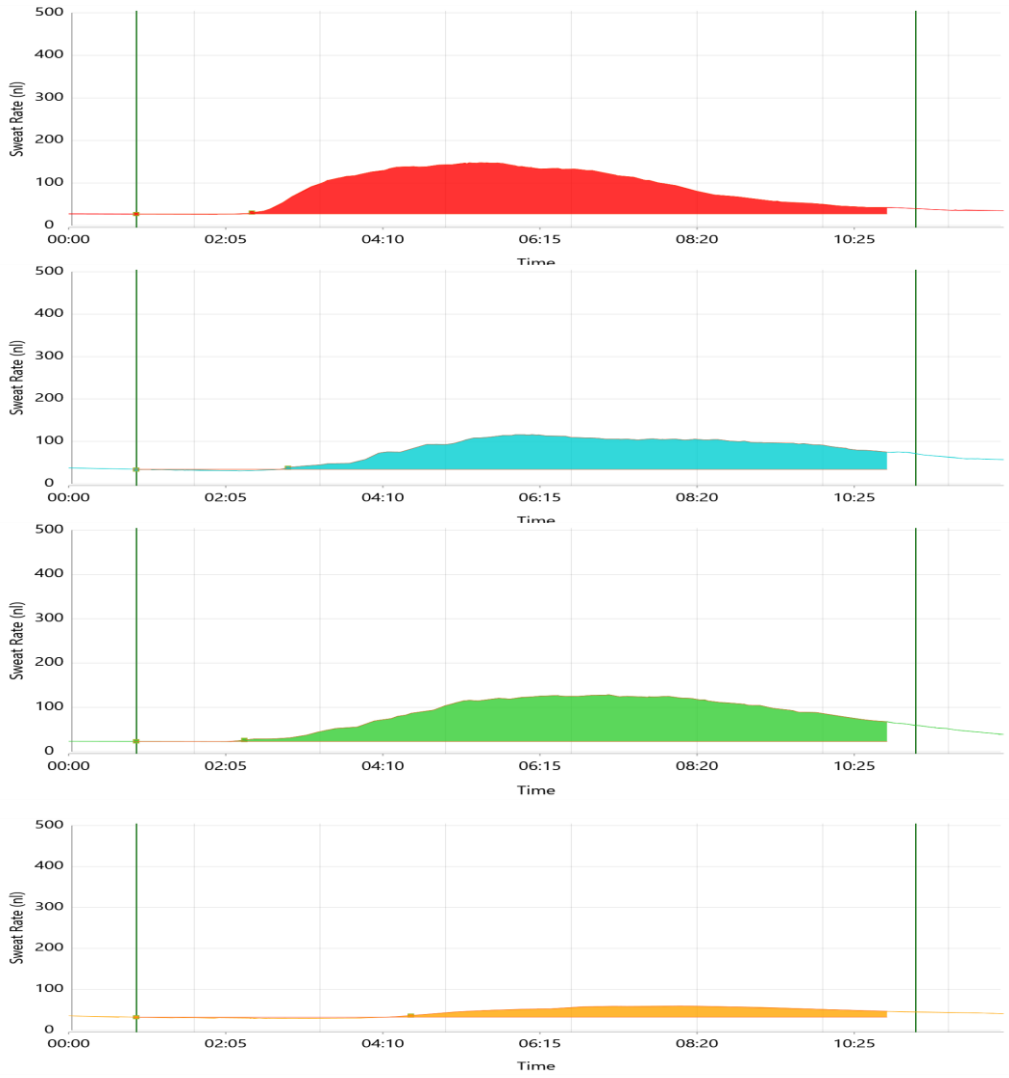


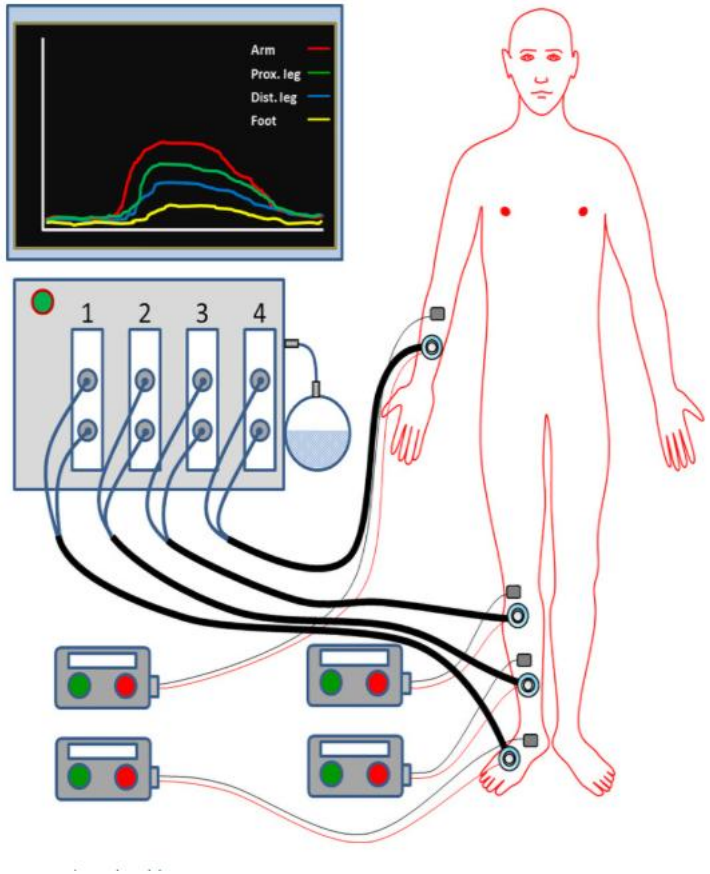
Dysautonomia Diagnosis

Autonomic Reflex Screen (Sudomotor Tests)



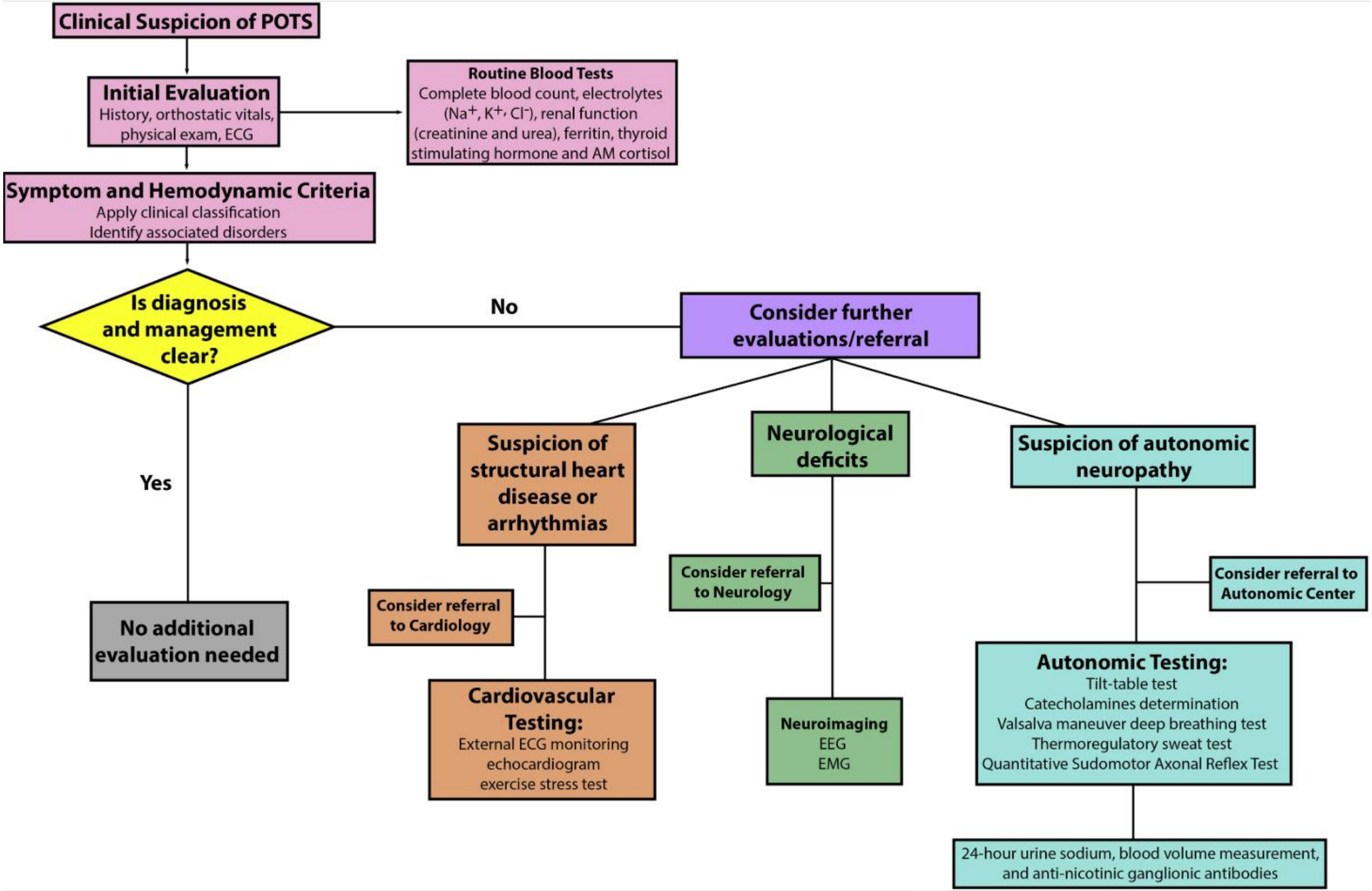
(Sudomotor Tests, Q-Sweat)





ScienceDirect

Autonomic “failure” versus “dysfunction”


Clinical Suspicion of POTS
Initial Evaluation
History, orthostatic vitals, physical exam, ECG
Routine Blood Tests
Complete blood count, electrolytes (Na^+, K^+, Cl^-), renal function (creatinine and urea), ferritin, thyroid stimulating hormone and AM cortisol
Symptom and Hemodynamic Criteria
Apply clinical classification
Identify associated disorders
Is diagnosis and management clear?
No
Yes
No additional evaluation needed
Consider further evaluations/referral
Suspicion of structural heart disease or arrhythmias
Consider referral to Cardiology
Cardiovascular Testing:
External ECG monitoring
echocardiogram
exercise stress test
Neurological deficits
Consider referral to Neurology
Neuroimaging
EEG
EMG
Suspicion of autonomic neuropathy
Consider referral to Autonomic Center
Autonomic Testing:
Tilt-table test
Catecholamines determination
Valsalva maneuver deep breathing test
Thermoregulatory sweat test
Quantitative Sudomotor Axonal Reflex Test
24-hour urine sodium, blood volume measurement, and anti-nicotinic ganglionic antibodies

Post Acute Sequalae of COVID (PASC)

POTS and SFN

- Recent reports indicate that 2%–14% of coronavirus disease 2019 (COVID-19) survivors develop POTS and 9%–61% experience POTS-like symptoms, such as tachycardia, orthostatic intolerance, fatigue, and cognitive impairment within 6–8 months of severe acute respiratory syndrome (SARS-CoV-2) infection.

- pathophysiological mechanisms of post–COVID-19 POTS are not well understood. Current hypotheses include autoimmunity related to SARS-CoV-2 infection, autonomic dysfunction, direct toxic injury by SARS-CoV-2 to the autonomic nervous system, and invasion of the central nervous system by SARS-CoV-2.

- 89% of PASC patients have evidence of SFN, compared to 60% in POTS patients.

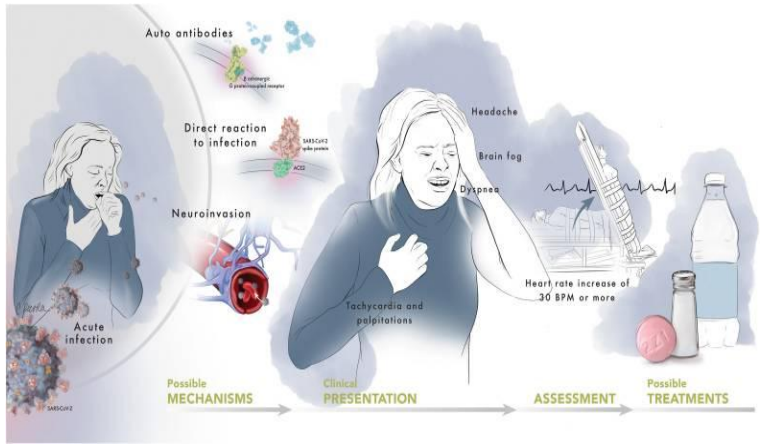


Illustration provided by Christina Pecora, MSMI, CMI

Ormiston et al, Heart Rhythm Nov 2022

Novak et al. , Ann Neurology, Mar 2022

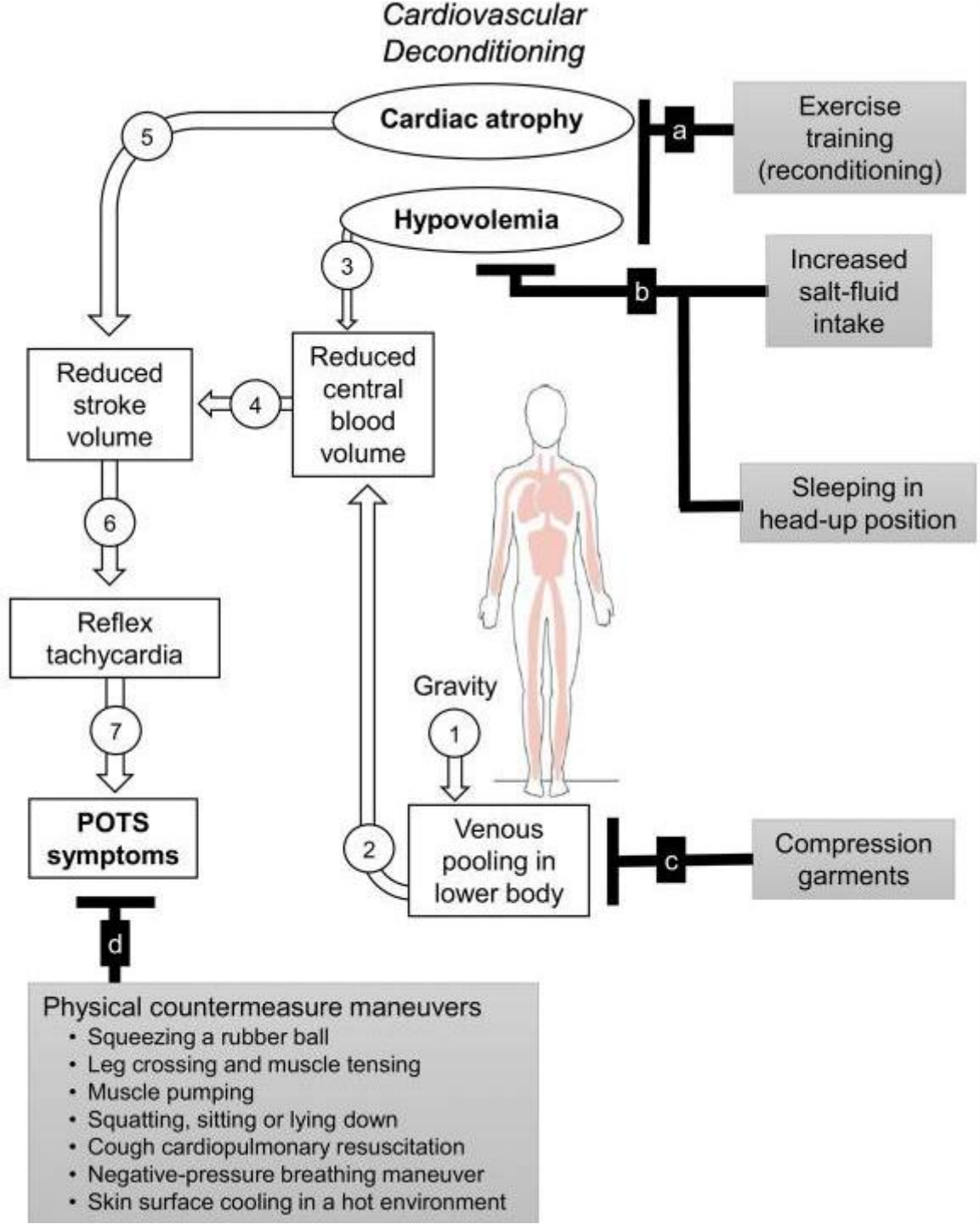
Treatment of orthostatic intolerance

Nonpharmacological treatments

- All started at initial visit
  - Water 3 L/d
  - Salt 2 tsp/d
  - Waist-high compression garments

• Pharmacological treatments

- May start at initial visit if symptoms are severe
  - If standing heart rate very high: propranolol 10–20 mg, 4 times per day
  - If standing heart rate very high and β-blocker is contraindicated: ivabradine 5 mg 2 times per day
  - If standing heart rate is not too high and blood pressure is low: midodrine 5 mg orally every 4 hours, 3 times per day (8 am, noon, 4 pm)


Cardiovascular Deconditioning
Cardiac atrophy
Hypovolemia
5
3
a
Exercise training (reconditioning)
b
Increased salt-fluid intake
Sleeping in head-up position
Reduced stroke volume
4
Reduced central blood volume
6
Reflex tachycardia
7
POTS symptoms
Gravity
1
2
Venous pooling in lower body
c
Compression garments
d
Physical countermeasure maneuvers
• Squeezing a rubber ball
• Leg crossing and muscle tensing
• Muscle pumping
• Squatting, sitting or lying down
• Cough cardiopulmonary resuscitation
• Negative-pressure breathing maneuver
• Skin surface cooling in a hot environment

Managing Orthostatic Symptoms: Practical Strategies for Daily Life

HYDRATION

- Aim for 2–3 liters of fluids daily
- Start hydration early in the morning
- Use electrolyte-containing fluids, not water alone
- Sip fluids consistently throughout the day

SALT

- 3000–4000 grams elemental sodium per day (≈8–12 grams of sodium chloride)
- Increase salt intake only if advised
- Pair salt with fluids for best effect
- Options include:
  - Salted foods or broths
  - Electrolyte drinks with sodium
  - Salt tablets or capsules
- Spread intake across meals and snacks

POSITION & MOVEMENT

- Rise slowly from lying → sitting → standing
- Avoid prolonged standing when possible
- Use counter-maneuvers if symptoms begin:
  - Leg crossing
  - Calf tightening
  - Squatting or sitting down

DAILY ROUTINES

- Hydrate before getting out of bed
- Plan demanding activities later in the day
- Avoid skipping meals
- Heat, illness, and dehydration can worsen symptoms
- Slight head-of-bed elevation during sleep can improve tolerance to standing

COMPRESSION

- Waist-high or abdominal compression works best (30 mm Hg of ankle counter pressure)
- Most helpful during:
  - Prolonged standing
  - Travel
  - Symptom flares
- Comfort and consistency matter more than perfection

ACTIVITY & EXERCISE

- Begin gradually — consistency over intensity
- Start with recumbent or seated exercise
- Avoid sudden upright exertion early on
- Deconditioning can worsen symptoms

KEY MESSAGE Improvement is often **gradual**. Small daily habits make a meaningful difference over time

Pharmacological treatments for postural orthostatic tachycardia syndrome

Drug	Dosing	Quality of evidence*	Adverse effects
Heart rate inhibitors			
Propranolol	10–20 mg orally up to 4 times daily	Moderate	Hypotension, bradycardia, bronchospasm
Ivabradine	2.5–7.5 mg orally twice daily	Moderate	Visual disturbances, bradycardia
Pyridostigmine	30–60 mg orally up to 3 times daily	Low	Increased gastric motility and cramping
Vasoconstrictors			
Midodrine	2.5–15 mg orally 3 times daily	Moderate	Headache, scalp tingling, supine hypertension
Sympatholytic drugs			
Methyldopa	125–250 mg orally twice daily	Low	Hypotension, fatigue, brain fog
Clonidine	0.1–0.2 mg orally 2–3 times daily or long-acting patch	Low	Hypotension, fatigue, brain fog
Blood volume expanders			
Fludrocortisone	0.1 to 0.2 mg orally per day	Low	Hypokalemia, edema, headache
Desmopressin	0.1 to 0.2 mg orally per day, as needed	Low	Hyponatremia, edema

Mass General Brigham
Wentworth-Douglass Hospital

Rehabilitation Services

Postural Orthostatic Tachycardia Syndrome Rehab Program

Postural Orthostatic Tachycardia Syndrome, or POTS, is a condition that causes a person's heart to beat too fast and can make them feel dizzy when they stand up. Many people with POTS may also feel tired, have pain, have trouble thinking clearly and have headaches. These symptoms can make it difficult to exercise and do the things that they need or want to do each day.

The Wentworth-Douglass Hospital (WDH) Rehabilitation Services team is here to help you manage your symptoms and make it easier for you to enjoy activities that matter to you. The POTS program at WDH is customizable and suitable for everyone, no matter the age or ability. Our team includes specially trained physical therapists, occupational therapists, and speech therapists. The team uses specific exercise plans, provides education, teaches use of adaptive equipment, as well as cognitive strategies, to improve how you feel and help achieve your personal goals.

In addition to traditional exercise machines, our program includes a tilt table and aquatic therapy.

WDH provides many services for patients who have POTS including:

- Cardiology
- Neurology
- Integrative Therapy
- Social Work
- Nutrition

Once you have reached your rehabilitation goals, our team can help you move on to a more independent program that is right for you. We offer transition programs at The Works and the Center for Athletes. Our providers understand how to create long-term exercise plans for people with POTS, please ask your therapist about this option.

WDH has a free transportation service Care-Van for patients within a certain radius who are unable to provide their own transportation to their rehabilitation appointments. Please ask about this service when you are contacted to schedule your evaluation.

If you want to learn more, please speak with your doctor or call Wentworth-Douglass Hospital Rehabilitation Services at 603-740-2101.

The Levine Protocol for POTS

Phase 1 (Months 1-2): Horizontal Exercise Focus
•Recumbent biking
•Rowing machine
•Swimming (especially with a kickboard)
•Seated strength training

Phase 2 (Months 3-4): Gradual Upright Progression
•Upright biking
•Elliptical training (without arm motion at first)
•Light treadmill walking (flat surface)

Phase 3 (Months 5-7): Full Upright and Interval Training
Elliptical with arm motion
Inclined treadmill walking
Light jogging (only if tolerated)
High-intensity interval training (introduced cautiously)

Utah ADaPT Program

Utah ADaPT Program

2C. Summary of Stages:

Preconditioning State:	**Start in Preconditioning State if:** • If unable to engage conditioning tasks of Stage 1 and beyond • Diagnosis of Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (**ME/CFS**)[16,17,18] • Signs of post-exertional malaise (**PEM**) on PEM screening questionnaire Section 5B. Tools	Prescribed activities: • Avoid sustained aerobic activity; rather, focus on pacing techniques • Practice deep breathing and autonomic quieting exercises, mindfulness • Use adaptive devices and bracing as indicated • Range of motion and mobilization as directed by provider See Sections 5C for additional details.
Stage 1: **Supine** exercise	**1: Supine wall slides, heel slides** Starting intensity determined by: • Target HR at 15-20 bpm above resting supine HR measured on Active Stand Test. Section 5A: Tools **OR:** • Intensity that produces 2/10 RPE. If significantly worsening symptoms (VAS>3/10) with Stage 1 exercise – consider Preconditioning criteria. If in supine position (1), patient maxes out in intensity before reaching HR threshold – consider transition to recumbent (2).	
Stage 2: **Recumbent** exercise	**2: Recumbent biking, rowing** Starting intensity determined by: • Target HR at 15-20 bpm above resting supine HR measured on Active Stand Test. Section 5A: Tools **OR:** • Intensity that produces 2/10 RPE.	
Stage 3: **Seated** exercise	**Upright stationary bike** Starting intensity determined by: • Target HR at 15-20 bpm above resting seated HR. **OR:** • Intensity that produces 2/10 RPE. Upon advancing from Stage 3 to 4, exertional testing is recommended as a tool to evaluate and track patient progress and exercise tolerance (see Section 4C for Functional Evaluation and Exertional Testing tools).	
Transition to upright exercise should be confirmed by exertional testing (BCTT). Patient should tolerate test for at least 1 minute without symptom increase and without HR exceeding the target HR zone from the end of Stage 3.		
Stage 4: **Walking** Program	**Treadmill/walking** Starting intensity determined by: • Initial target HR zone during walking will be the same target HR prescribed for the patient at the end of Stage 3 (upright/seated biking). • For patients struggling with upright intolerance, initial walking target HR can be determined by resting HR + 15-20 bpm **OR:** • Intensity that produces 2/10 RPE.	

WDH POTS Rehab program

- Individualized Exercise Plan (Exercise prescription)
- Physical therapy
- Occupational therapy
- Speech language pathology
- Acupuncture
- Order set

KEY POINTS

- *Postural tachycardia syndrome (POTS) is a chronic multisystem disorder; the cardinal feature is orthostatic tachycardia.*

- *Patients with POTS have symptoms of orthostatic intolerance that improve with recumbence.*

- *Girls and women are more commonly affected with POTS, beginning in puberty and through early adulthood.*

- *Postural tachycardia syndrome can lead to marked functional disability, often limiting work or schooling.*

- *Treatments for POTS can improve symptoms and function, and can be initiated at the initial visit.*

Thank You