

Postural Orthostasis-Tachycardia Syndrome and Inappropriate Sinus Tachycardia

26 February 2024

Leon M Ptaszek, MD, PhD, FACC, FHRS
Assistant Professor of Medicine, Harvard Medical School



HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL



MASSACHUSETTS
GENERAL HOSPITAL

CORRIGAN MINEHAN
HEART CENTER

1. *Understand the pathophysiology of POTS/IST.*
2. *Identify distinct clinical syndromes whose presentations overlap with POTS/IST.*
3. *Select appropriate diagnostic testing (and appropriate consultants) for evaluation of suspected POTS/IST.*
4. *Identify available treatment strategies for POTS/IST.*

1. *Understand the pathophysiology of POTS/IST.*
2. *Identify distinct clinical syndromes whose presentations overlap with POTS/IST.*
3. *Select appropriate diagnostic testing (and appropriate consultants) for evaluation of suspected POTS/IST.*
4. *Identify available treatment strategies for POTS/IST.*

Question 1:

Which of the following patients is most likely has POTS/IST?

1. 67-year-old male with poorly controlled diabetes mellitus who presents with lightheadedness upon standing.
2. 88-year-old woman with heart failure who presents with lightheadedness after taking her prescribed diuretic medication.
3. 32-year-old woman with no known heart disease who presents with reproducible lightheadedness upon standing.
4. 46-year-old woman with no known heart disease who presents with heralded syncope during blood draws.

Question 1:

Which of the following patients is most likely has POTS/IST?

1. 67-year-old male with poorly controlled diabetes mellitus who presents with lightheadedness upon standing.
2. 88-year-old woman with heart failure who presents with lightheadedness after taking her prescribed diuretic medication.
3. 32-year-old woman with no known heart disease who presents with reproducible lightheadedness upon standing.
4. 46-year-old woman with no known heart disease who presents with heralded syncope during blood draws.

Definition: Postural Tachycardia Syndrome

Postural tachycardia syndrome (POTS) is defined as a clinical syndrome that is usually characterized by (1) frequent symptoms that occur with standing such as lightheadedness, palpitations, tremulousness, generalized weakness, blurred vision, exercise intolerance, and fatigue; (2) an increase in heart rate of ≥ 30 bpm when moving from a recumbent to a standing position held for more than 30 seconds (or ≥ 40 bpm in individuals 12 to 19 years of age); and (3) the absence of orthostatic hypotension (>20 mm Hg drop in systolic blood pressure).

Taken from Heart Rhythm Society Expert Consensus Statement (2015):
Sheldon RS et al, Heart Rhythm 2015;12:e41-e63

Definition: Inappropriate Sinus Tachycardia

The syndrome of inappropriate sinus tachycardia is defined as a sinus heart rate >100 bpm at rest (with a mean 24-hour heart rate >90 bpm not due to primary causes) and is associated with distressing symptoms of palpitations.

Taken from Heart Rhythm Society Expert Consensus Statement (2015):
Sheldon RS et al, Heart Rhythm 2015;12:e41-e63

Mechanisms Responsible for POTS/IST

- Hyperadrenergic stimulation
- Hypervigilance
- Deconditioning
- Peripheral autonomic denervation (small fiber neuropathy)
- Hypovolemia

Cardiovascular

- Orthostatic intolerance, tachycardia
- Palpitations, dizziness, lightheadedness
- Exercise intolerance
- Chest discomfort
- Acrocyanosis/Raynaud's phenomenon
- Lower extremity edema

Non-cardiovascular

- General deconditioning, chronic fatigue
- Cognitive impairment, brain fog, concentration problems
- Muscle fatigue/weakness/pain
- Hyperventilation, shortness of breath, diaphoresis
- Bladder dysfunction, nocturia, polyuria
- Skin erythema/petechiae, pallor, flushing

Who tends to have POTS/IST?

- Prevalence $\leq 1\%$
- Patients are typically young (age 15-50 years)
- Female predominance (5:1 over males)

1. *Understand the pathophysiology of POTS/IST.*
2. *Identify distinct clinical syndromes whose presentations overlap with POTS/IST.*
3. *Select appropriate diagnostic testing (and appropriate consultants) for evaluation of suspected POTS/IST.*
4. *Identify available treatment strategies for POTS/IST.*

Question 2:

Which of the following best describes the sequence of events leading to POTS/IST?

1. Postural blood pooling in lower extremities associated with vasodepressor response followed by cardioinhibitory response.
2. Postural blood pooling in lower extremities associated with vasodepressor response followed by cardiostimulatory response.
3. Cardioinhibitory response to noxious stimulus (e.g., pain) followed by vasodepressor response.
4. Cardiostimulatory response to noxious stimulus (e.g., pain) followed by vasostimulatory response.

Question 2:

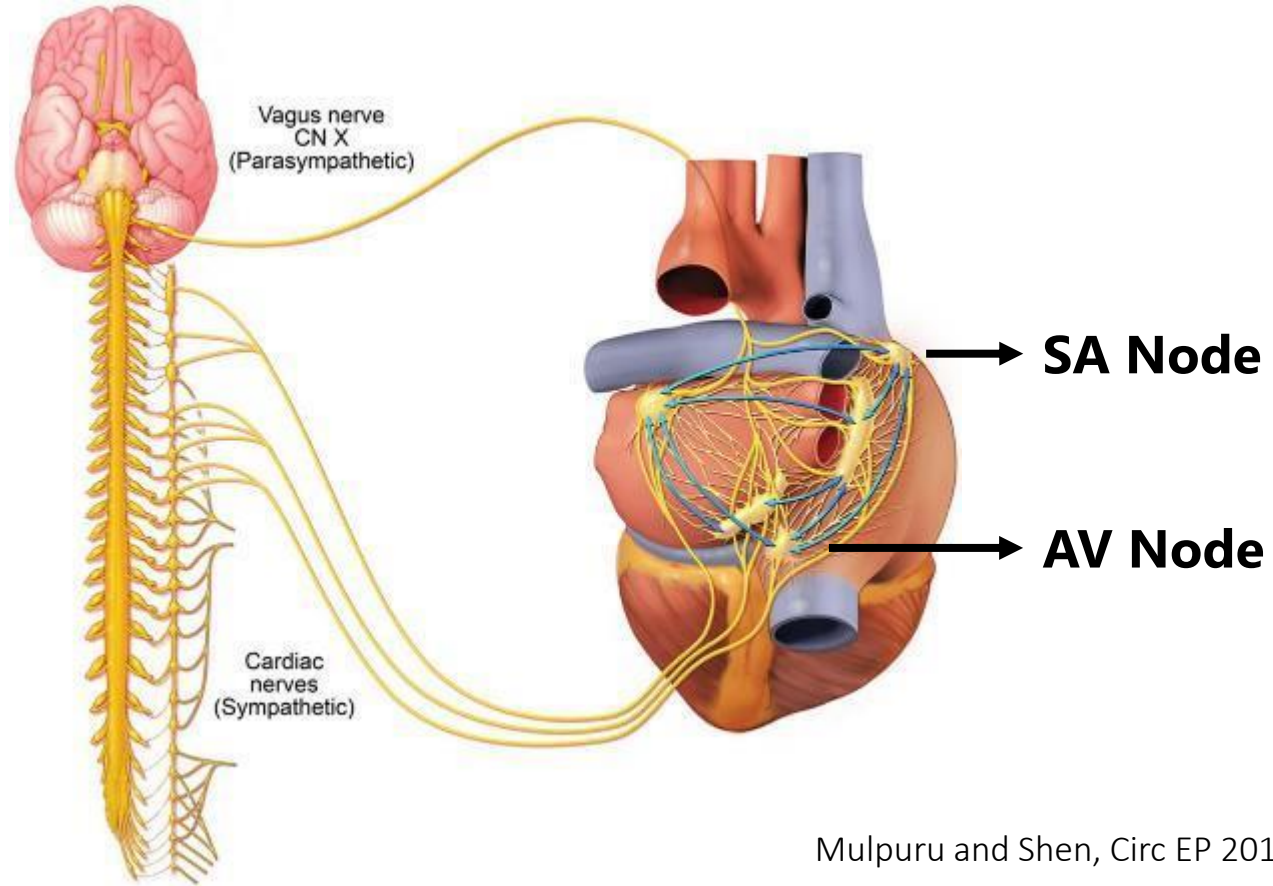
Which of the following best describes the sequence of events leading to POTS/IST?

1. Postural blood pooling in lower extremities associated with vasodepressor response followed by cardioinhibitory response.
2. Postural blood pooling in lower extremities associated with vasodepressor response followed by cardiostimulatory response.
3. Cardioinhibitory response to noxious stimulus (e.g., pain) followed by vasodepressor response.
4. Cardiostimulatory response to noxious stimulus (e.g., pain) followed by vasostimulatory response.

Orthostatic intolerance can be due to several issues:

- POTS
- Orthostatic hypotension (dehydration, medications, neuropathy)
- Reflex syncope (vasovagal reaction to pain, external stimuli)
- Benign sinus tachycardia

Autonomic Nervous System: Impact on Heart Rhythm, Blood Pressure



Distinguishing Features among Orthostatic Intolerance Syndromes

Condition	BP	HR	Symptoms
POTS	↓	↑	+
Orthostatic hypotension	↓	↑	+
Reflex syncope	↓↓	↓	+
Benign tachycardia	↔	↑	-

Patients with POTS may also have:

- Mast cell activation syndrome (MCAS)
- Ehlers Danlos Syndrome (EDS)
- Autoimmune disease, often ANA (+)
- Sjogren's syndrome
- Lupus erythematosus
- Rheumatoid arthritis
- Autoimmune thyroid disease (Grave's, Hashimoto's)
- Gastroparesis, IBS, SIBO
- Migraine headaches
- Sinus node disease
- Chronic immune deficiency
- Chronic regional pain syndromes
- Raynaud's syndrome
- Depression/anxiety
- Urologic conditions (pelvic floor dysfunction, interstitial cystitis, endometriosis, PCOS)
- Chiari malformation

1. *Understand the pathophysiology of POTS/IST.*
2. *Identify distinct clinical syndromes whose presentation overlaps with POTS/IST.*
3. *Select appropriate diagnostic testing (and appropriate consultants) for evaluation of suspected POTS/IST.*
4. *Identify available treatment strategies for POTS/IST.*

Question 3:

26-year-old woman with no medical history presents with postural lightheadedness and sudden, rapid heart rate with minimal walking. Which is the best, first step in her evaluation for possible POTS/IST:

1. Tilt-table study.
2. Exercise stress test.
3. Orthostatic BP/HR measurement.
4. Ambulatory arrhythmia monitoring.

Question 3:

26-year-old woman with no medical history presents with postural lightheadedness and sudden, rapid heart rate with minimal walking. Which is the best, first step in her evaluation for possible POTS/IST:

1. Tilt-table study.
2. Exercise stress test.
3. **Orthostatic BP/HR measurement.**
4. Ambulatory arrhythmia monitoring.

Investigation of POTS/IST

	Class	Level
A complete history and physical exam with orthostatic vital signs and 12-lead ECG should be performed on patients being assessed for POTS.	I	
Complete blood count and thyroid function studies can be useful for selected patients being Assessed for POTS.	IIa	E
A 24-hour Holter monitor may be considered for selected patients being assessed for POTS, although its clinical efficacy is uncertain.	IIb	E
Detailed autonomic testing, transthoracic echocardiogram, tilt-table testing, and exercise stress testing may be considered for selected patients being assessed for POTS.	IIb	E

Taken from Heart Rhythm Society Expert Consensus Statement (2015):
Sheldon RS et al, Heart Rhythm 2015;12:e41-e63

Patient Description of Symptoms

- Orthostatic intolerance vs. presyncope/syncope
- Exercise intolerance due to tachycardia

Pertinent Medical History

- Absence of medical issues associated with orthostasis

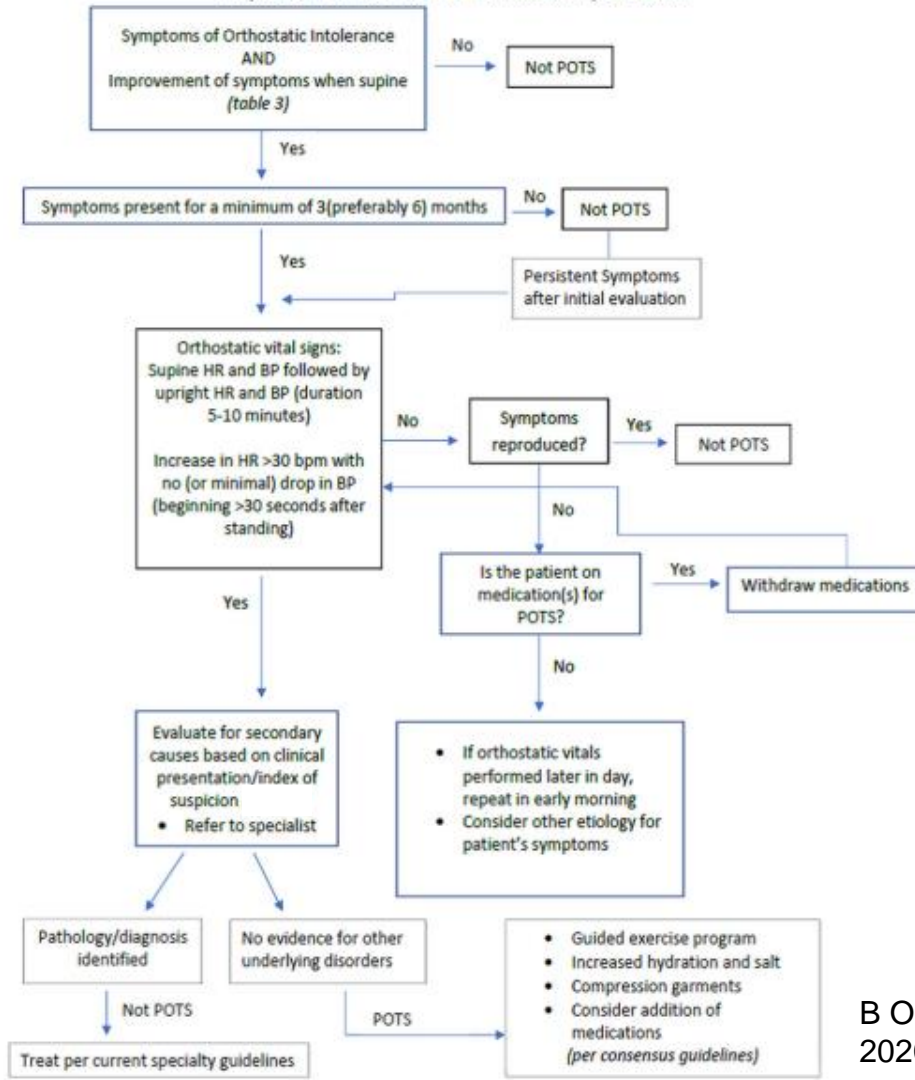
Physical Exam

- Absence of signs/symptoms of structural heart disease

Testing

- No arrhythmias or evidence of structural heart disease or major non-cardiac issues

Proposed Clinical Evaluation for Adult with Suspected POTS



1. *Understand the pathophysiology of POTS/IST.*
2. *Identify distinct clinical syndromes whose presentations overlap with POTS/IST.*
3. *Select appropriate diagnostic testing (and appropriate consultants) for evaluation of suspected POTS/IST.*
4. *Identify available treatment strategies for POTS/IST.*

Question 4:

A patient is diagnosed with POTS/IST based on the results of diagnostic testing. What is the most appropriate first line of therapy?

1. Florinef
2. Midodrine
3. Increased hydration/salt intake with graded exercise exposure
4. Beta blocker

Question 4:

A patient is diagnosed with POTS/IST based on the results of diagnostic testing. What is the most appropriate first line of therapy?

1. Florinef
2. Midodrine
3. **Increased hydration/salt intake with graded exercise exposure**
4. Beta blocker

“Treatment of POTS is difficult; there are no therapies that are uniformly successful, and combinations of approaches are often needed. Few treatments have been tested with the usual rigor of randomized clinical trials, and there is no consensus as to whether specific treatments should be targeted to subsets of POTS...”

Taken from Heart Rhythm Society Expert Consensus Statement (2015):
Sheldon RS et al, Heart Rhythm 2015;12:e41-e63

Multidisciplinary approach

- Physicians, psychologists, nurses, occupational therapists, recreational therapists

Augmentation of BP

- Drink 2-3 liters of fluid daily
- Ingest 10-12 grams sodium chloride daily
- IV saline for acute decompensation

Tachycardia

- Propranolol, short-acting
- Ivabradine

Brain fog

- Clonidine, methyldopa (central sympatholytic, for hyperadrenergic state)
- Modafinil (for chronic fatigue, can worsen tachycardia)

Orthostasis

- Midodrine (alpha 1 agonist)
- Fludrocortisone

Treatment of POTS/IST

	Class	Level
A regular, structured, and progressive exercise program for patients with POTS can be effective.	IIa	B-R
It is reasonable to treat patients with POTS who have short-term clinical decompensations with an acute intravenous infusion of up to 2 L of saline.	IIa	C
Patients with POTS might be best managed with a multidisciplinary approach.	IIb	E
The consumption of up to 2–3 L of water and 10–12 g of NaCl daily by patients with POTS may be considered.	IIb	E
It seems reasonable to treat patients with POTS with fludrocortisone or pyridostigmine.	IIb	C
Treatment of patients with POTS with midodrine or low-dose propranolol may be considered.	IIb	B-R
It seems reasonable to treat patients with POTS who have prominent hyperadrenergic features with clonidine or alpha-methyldopa.	IIb	E
Drugs that block the norepinephrine reuptake transporter can worsen symptoms in patients with POTS and should not be administered.	III	B-R
Regular intravenous infusions of saline in patients with POTS are not recommended in the absence of evidence, and chronic or repeated intravenous cannulation is potentially harmful.	III	E
Radiofrequency sinus node modification, surgical correction of a Chiari malformation type I, and balloon dilation or stenting of the jugular vein are not recommended for routine use in patients with POTS and are potentially harmful.	III	B-NR



Thank you



MASSACHUSETTS
GENERAL HOSPITAL