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POTS: Postural Tachycardia Syndrome

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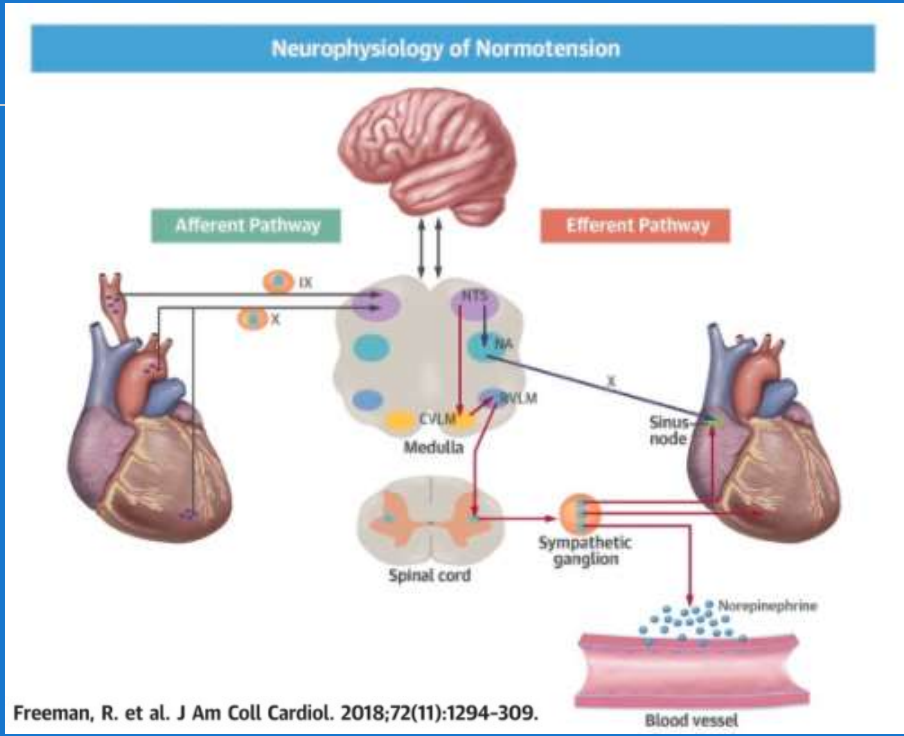
Introduction

- Upright posture -complex
- Failure -> orthostatic intolerance

  inability to tolerate upright posture
- Symptoms of cerebral hypoperfusion and/or sympathetic activation
- OH, syncope, and POTS



Freeman, R. et al. J Am Coll Cardiol. 2018;72(11):1294-309.

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Definition of POTS

Postural Tachycardia Syndrome Definition

(1) frequent symptoms that occur with standing

(2) increase in heart rate ≥ 30 bpm

(3) In the absence of OH

-2015 Consensus Statement, Sheldon et al.

Cerebral Hypoperfusion

Lightheadedness
Blurry vision
Cognitive difficulties
Generalized weakness

Excessive Sympathoexcitation

Palpitations
Chest pain
Tremulousness
Sweating
Pallor
Nausea
Diarrhea
Cold extremities

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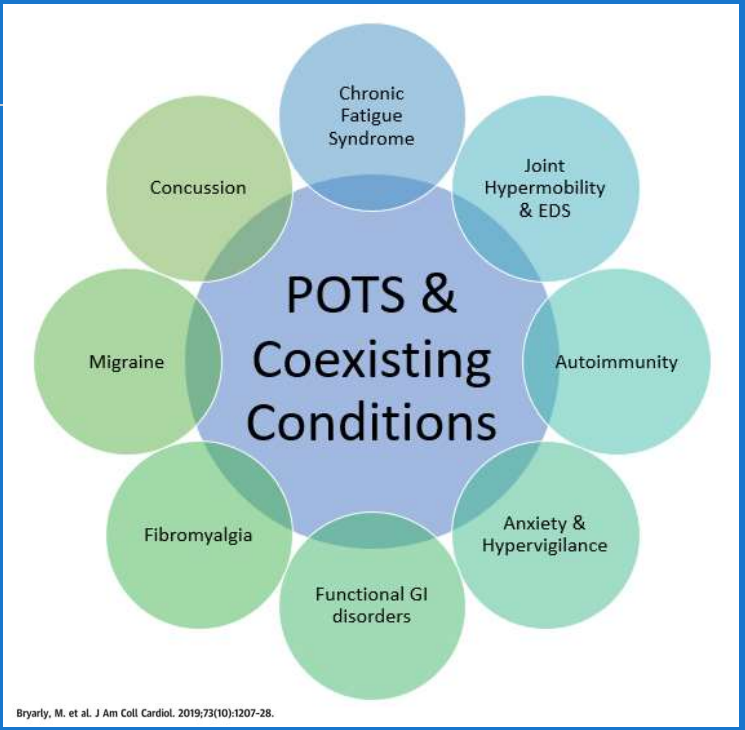
Demographics & Associated Conditions

- Young women
  - *Ages 15-50 yo*
  - *F:M 4.5:1*
- Triggered by infectious illness or post-surgical
- Often co-exists with many non-orthostatic symptoms



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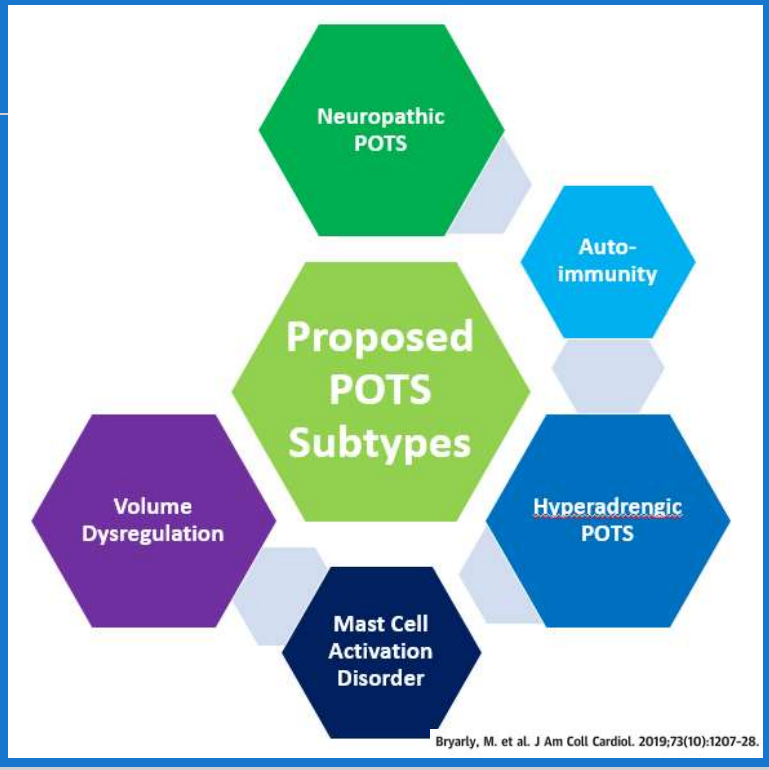
Pathophysiology of POTS

- Not one disorder-> heterogenous syndrome
  - *Result of several different (not exclusive) mechanisms*
  - *Causing susceptibility to developing POTS*
- Neuropathic POTS
  - *Length dep neuropathy -> venous pooling*
- Autoimmunity
- Hyperadrenergic POTS
  - *Excessive sympathetic activity*
- Volume dysregulation
  - *Dec renin & aldosterone activity*
- Mast Cell Activation Disorder



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Deconditioning

POTS characteristics:

- *Reduced cardiac size & mass (by 16%)*
- *Reduced blood volume (20%)*
- *Reduced stroke volume*
- *Reduced VO2 peak*

**compared to matched sedentary controls*

Table 1 Subject Characteristics

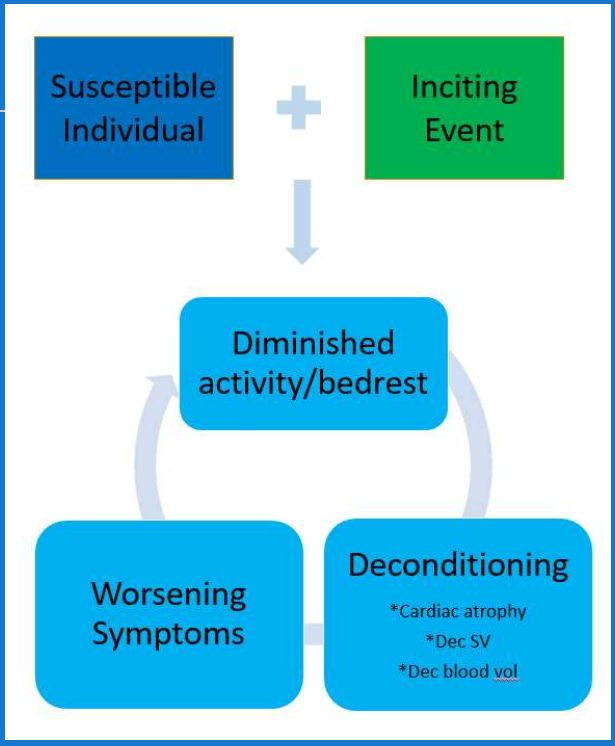
Variables	POTS Patients (n = 26 Women, 1 Man)	Healthy Controls (n = 15 Women, 1 Man)
Age (yrs)	26 (21, 33)	28 (23, 35)
Height (cm)	163 (161, 172)	166 (162, 172)
Weight (kg)	64 (57, 70)	63 (56, 68)
Body mass index (kg/m^2)	23 (22, 26)	22 (21, 24)
Screening supine heart rate (beats/min)	88 (77, 93)*	72 (64, 77)
10-min stand heart rate (beats/min)	114 (108, 131)*	89 (77, 99)
Changes in heart rate (beats/min)	32 (24, 38)*	17 (10, 22)
Supine hematocrit (%)	39 (37, 40)	38 (36, 40)
Blood volume (ml/kg)	60 (54, 64)*	71 (65, 78)
Plasma volume (ml/kg)	39 (36, 43)*	49 (44, 52)
Left ventricular mass (g/kg)	1.26 (1.12, 1.37)*	1.45 (1.34, 1.57)
Left ventricular end-diastolic volume (ml/m^2)	60 (52, 65)	64 (57, 70)

Values are presented as median (25th, 75th percentiles). *$p < 0.01$ versus healthy controls.
POTS = postural orthostatic tachycardia syndrome.

Orthostatic tachycardia = compensatory response

- *Increased cardiac size/mass & expanded blood volume –> correlates with improved symptoms following exercise training*

•Fu et al, "Cardiac Origins of the Postural Orthostatic Tachycardia Syndrome"



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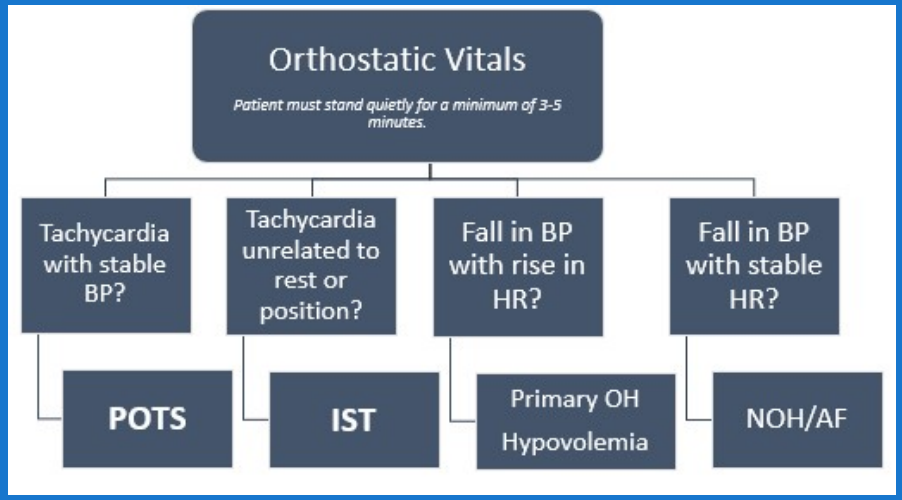
Diagnosing POTS

Medical history

- *Precipitating factors*
- *Sx's exclusively in upright position*
- *Excerbating factors*

Medication history

Orthostatic vitals



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Treatment

POTS Treatment Algorithm

Try non-pharmacologic measures first

(raise HOB, liberal hydration, graded exercise program for 3 months, compression garments, etc.)

In severe cases, can consider adding medication while initiating exercise program

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POTS and Exercise

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Objectives

- Understand the non pharmacological approach to POTS treatment
- Learn the steps of a POTS Physical Therapy evaluation
- Understand how Physical Therapy plays a role in POTS treatment
- Learn about the POTS training program
- Learn tips for discussing patient education regarding exercise and POTS

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Why exercise for POTS patients?

- Patients with POTS have exercise intolerance. (Fu and Levine, 2015)
- Recent research has demonstrated that cardiovascular deconditioning (cardiac atrophy and hypovolemia) contributes significantly to POTS and its functional disability. (Fu and Levine, 2018)
- Short term exercise training increases cardiac size and mass, blood volume, and VO2 peak in POTS patients. (Fu and Levine, 2015)
- In the POTS registry, the vast majority of patients who completed 3 months of exercise training/lifestyle intervention no longer qualified for POTS criteria and were thus in remission. (George et al., 2016)

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Role Of Physical Therapy

- Education
  - Water and sodium intake
  - Elevate the head of the bed
  - Be upright while awake
- Instruction on Training Calendars
  - Start on one horizontal mode of training
  - Try not to take more than 2 days of exercise off
- Instruction on equipment
  - Education on gym equipment (recommend joining gym)
  - HR monitor with chest strap
  - RPE chart

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Evaluation

- Subjective
- Resting HR after 10 minutes of supine or resting HR from Tilt Table test
- Calculate the specific heart zone (if off beta blockers) and correlate each HR zone with RPE (scale of 6-20)
- Clinical decision on which month to start patient based on patient presentation
  - Pre Month 1 versus Month 1
- Education on what to expect from the program

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Example of POTS training guidelines

The Heart Rate Zones below are for OFF beta blockers ONLY.
Remaining on a Beta Blocker? Follow the expected RPE only.

Training Zone	Heart Rate (bpm)	Expected RPE
Intervals	>193	19-20
Race Pace	182-193	
Maximal Steady State, MSS	171-181	16-18
Base Pace	151-170	13-15
Recovery	<151	6-12

Rating of Perceived Exertion (RPE):
Subjective rating of the entire cardio workout on a scale of 6 to 20:

- 6 is very, very easy
- 11 is fairly easy
- 13 is somewhat hard
- 15 is hard
- 17 is very hard
- 19 is very, very hard

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POTS Exercise Optional PRE Training Program

Pre-Month 1

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2 **Training Mode 1** 5-10 min Warm Up 3 min Base Pace 2 min recovery 3 min Base Pace 5-10 min Cool Dwn	3 **Weight Training**	4 **Training Mode 1** 5-10 min Warm Up 3 min Base Pace 2 min recovery 3 min Base Pace 5-10 min Cool Dwn	5 **Weight Training**	6 **Training Mode 1** 5-10 min Warm Up 3 min Base Pace 2 min recovery 3 min Base Pace 5-10 min Cool Dwn	7
8	9 **Training Mode 1** 5-10 min Warm Up 4 min Base Pace 3 min recovery 4 min Base Pace 5-10 min Cool Dwn	10 **Weight Training**	11 **Training Mode 1** 5-10 min Warm Up 4 min Base Pace 3 min recovery 4 min Base Pace 5-10 min Cool Dwn	12 **Weight Training**	13 **Training Mode 1** 5-10 min Warm Up 5 min Base Pace 3 min recovery 5 min Base Pace 5-10 min Cool Dwn	14
15	16 **Training Mode 1** 5-10 min Warm Up 5 min Base Pace 3 min recovery 5 min Base Pace 5-10 min Cool Dwn	17 **Weight Training**	18 **Training Mode 1** 5-10 min Warm Up 6 min Base Pace 3 min recovery 6 min Base Pace 5-10 min Cool Dwn	19 **Weight Training**	20 **Training Mode 1** 5-10 min Warm Up 6 min Base Pace 3 min recovery 6 min Base Pace 5-10 min Cool Dwn	21
22	23 **Training Mode 1** 5-10 min Warm Up 6 min Base Pace 3 min recovery 5 min Base Pace 5-10 min Cool Dwn	24 **Weight Training**	25 **Training Mode 1** 5-10 min Warm Up 7 min Base Pace 3 min recovery 5 min Base Pace 5-10 min Cool Dwn	26 **Weight Training**	27 **Training Mode 1** 5-10 min Warm Up 7 min Base Pace 3 min recovery 5 min Base Pace 5-10 min Cool Dwn	28

Training Mode 1 = any of: supine cycling, recumbent bike, swimming laps, swimming laps with a kick board, rowing (Concept II preferred)
Recovery = slow down, reduce resistance, get a drink, but don't stop moving
--Warm Ups and Cool Downs are done starting very slowly with little (or no) resistance and leading up to and out of your Base Pace HR zone.
--Physical therapist can begin with **supine cycling** only if a patient is beginning program as wheel-chair bound/bedridden.
--Weight Training can be done on same days as cardio workouts if necessary.

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POTS Exercise Training Program

Month 1

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	3 **Weight Training**	4 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	5 **Weight Training**	6 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	7
8	9 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	5 **Weight Training**	11 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	12 **Weight Training**	13 **Training Mode 1** 5 min Warm-Up 20 min **MSS** 5 min Cool-down	14 **Training Mode 1** 40 min Recovery
15	16 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	17 **Weight Training**	18 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	19 **Weight Training**	20 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	21
22	23 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down	24 **Weight Training**	25 **Training Mode 1** 5 min Warm-Up 25 min **MSS** 5 min Cool-down	26 **Training Mode 1** 40 min Recovery	27 **Weight Training**	28 **Training Mode 1** 5 min Warm-Up 30 min Base Pace 5 min Cool-down

Training Mode 1 = Any of: Recumbent Biking, Swimming, Rowing (Concept II preferred)
Weight Training can be done on same days as Cardio workouts if necessary.

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Cardiovascular Training

- Training begins in the horizontal mode then moving more upright
  - Swimming laps
  - Kickboard
  - Recumbent bike
  - Rowing
  - After about 2-3 months can transition to more upright equipment such as elliptical or treadmill as deemed appropriate

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Strength Training

- Weight training/Resistance training is done on seated equipment and should take about 25 minutes at a time with focus on lower body and core
  - This is done intentionally since lower body muscles act as pumps when they contract to increase venous return to the heart during orthostasis
- General recommendations include 2 sets of 10 reps of the following exercises – performing as many reps as you can on the 2nd set
  - For core exercises it is recommended at 2 sets of 10-20 reps as able

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Strength Training

Weight Training

- Seated leg press
- Leg curl
- Leg extensions
- Calf raises
- Chest press
- Seated row

Core Exercises

- Abdominal crunches
- Back extensions
- Side planks
- Pilates based core strengthening

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Special Considerations

- Ehlers-Danlos syndrome (hypermobility)
  - Start with non weight bearing exercises at mild intensity level and slowly increase at patient's tolerance (Fu and Levine, 2018)
- Concussion
  - Important for physical therapists treating concussion to be able to identify signs and symptoms of POTS with symptom exacerbation during orthostatic activity (Miranda et al., 2018)

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Discussing Exercise with POTS patients (Stiles et al, 2018)

- Do not give the impression that you are blaming the patient for their exercise intolerance.
- Acknowledge that anyone who has an orthostatic disorder would have difficulty exercising.
- Suggest that you will work together to gradually improve the patient's exercise capacity.
- Explain the physiological benefits of regular exercise, particularly its ability to increase blood volume, which is important in POTS.

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Summary

- Cardiac remodeling and blood volume expansion associated with exercise training increase physical fitness and improve exercise performance in these patients. (Fu and Levine, 2015)
- Education on what to expect for the program when first getting started is KEY!
  - Explaining that they might have increased fatigue/symptoms at the beginning but to stick with it

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Contact

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