Fundamentals of Autonomic Dysfunction – Perspectives from a Patient, Parent, and Health Care Provider

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Disclosures

- Financial:
  - None
- Conflicts:
  - None
- Off-Label Uses of Medications:
  - Midodrine, Metoprolol, SSRI – for autonomic dysfunction

Objectives

- Develop an approach to the diagnosis and management of tired teenagers.
- Understand both non-pharmacologic and pharmacologic therapy of adolescent autonomic dysfunction

Case 1

A 15 year old girl presents in October complaining of being “persistently tired” since the spring.

- Fatigue was better over the summer.
- Naps in afternoon since school started for 1-3 hours
- Previously A student
- Active in marching band, swim team, show choir.
- Dizzy when standing up (loses vision sometimes)
- Drags in the morning
- Headaches at least weekly
- Often nauseated

Fatigue is Common During Adolescence

*US Adolescent Girls Arch Pediatr Adolesc Med 158:797, 2004

31% with morning fatigue more than weekly

*Dutch Girls Pediatrics 117:e1078, 2006

21% with significant fatigue for > 3 months

*Dutch Boys Pediatrics 117:e1078, 2006

7% with significant fatigue for > 3 months

*British Teens Pediatrics 119:e603, 2007

2% with chronic disabling fatigue

Sleep Deprivation is Common During Adolescence

"Need" for Normal Sleep	9 hours/night
Average Amount of Sleep	7.5 hours/night

Kass. *Pediatr Rev* 27:455-462, 2006

What else might you assume about this 15 year old female?

a. She's not alone

b. She's probably sleep-deprived

c. Her life is probably out-of-balance

How many AP/honors classes does she have?

How many extracurricular activities does she have?

"Routine" Screening Tests

- Complete Blood Count
- Liver Enzymes
- BUN, Creatinine, Urinalysis
- Celiac screening – increased incidence in POTS patients
- Sedimentation Rate, CRP
- Thyroid Function Tests
- AM cortisol
- Iron studies
- Vitamin D level

Iron and Chronic Fatigue

- Adult Women with Chronic Fatigue

  Fatigue dropped by 29% with iron therapy

  - BMJ 326:1124, 2003
- Local Experience with Tired Teenagers

  27/54 with Ferritin < 20 ug/L
- 3-6 mg elemental iron/kg/d for 3+ mo
- Dietary counseling on iron rich diet

Vitamin D and Chronic Fatigue

- Adults with Non-Specific Pain

  Persistent non-specific musculoskeletal pain highly associated with hypovitaminosis D

  Mayo Clin Proc 78:1463, 2003

- Local Experience - Tired, Hurting Teenagers

  12 of 33 with 25OH-D < 25 ng/mL

- 400 – 2000 IU daily for months/maintenance therapy

After a good history and physical exam, what else might you do?

a. Screening laboratory tests

b. **Sleep evaluation** (send her to sleep medicine for sleep study if indicated)

Restless Leg Syndrome

- 2% of 12-17 year olds
  - 70% with positive family history
- Characterized by:
  - Urge to Move & Unpleasant Leg Sensations
- Associated with:
  - “Growing Pains” (81%)
  - Disturbed Sleep (69%)
  - Altered Mood (50%)

Picchietti. Pediatrics 120:253, 2007

After a good history and physical exam, what else might you do?

a. Screening laboratory tests
b. Sleep evaluation
c. **Autonomic nervous system testing**

A 15 year old girl comes to see you because of dizziness.

0.1% see a physician for syncope.

Driscoll. *J Am Coll Cardiol* 29:1039, 1997

25% report postural dizziness.

Skinner. *J Child Neurol*, 2010

Fatigue and Autonomic Dysfunction

*Fatigue often following illness

High fever, mononucleosis, post COVID 19

*Fatigue often seen with additional symptoms

Pains, dizziness, nausea

*Fatigue often seen with specific signs

Hyperextensibility

Large pupils

Bluish distal extremities when standing still

Postural tachycardia (> 40 bpm change)

Diagnosis of POTS

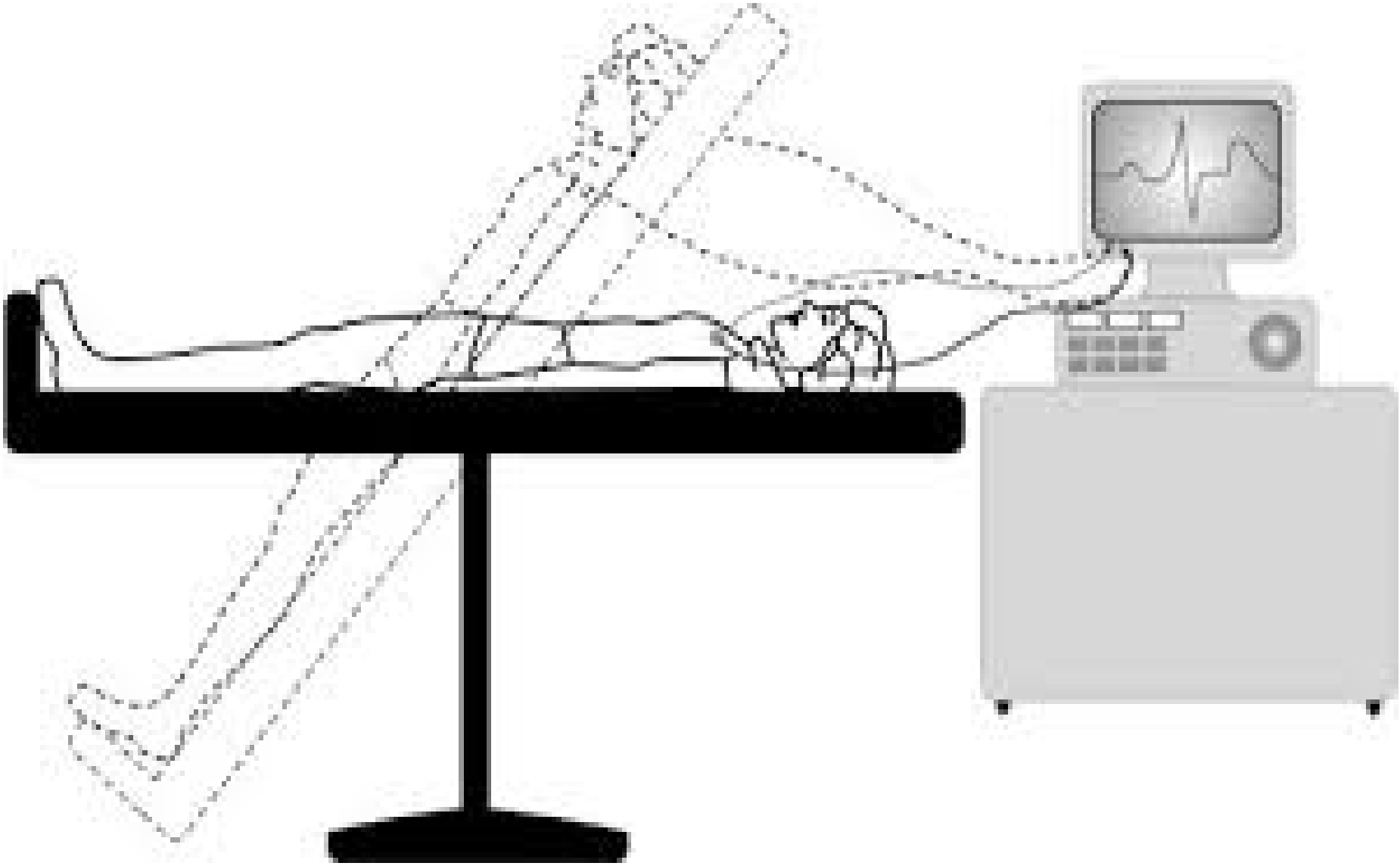
- Based on symptoms PLUS postural tachycardia
- Can check supine (calm for several minutes) and standing (still like a statue for at least three minutes) heart rates

OR

- Can do formal tilt table testing

Common symptoms

Dizziness
Fatigue
Stomach pain
Vision changes
Increased HR
Mood changes
Fainting
Headaches
Nausea
sweating



Postural Orthostatic Tachycardia Syndrome POTS

- Fatigue with other symptoms and a postural heart rate change of more than 30 (adults) or 40 (adolescents)

Singer et al. *J Pediatr* 160:222, 2012

- Autonomic dysfunction is umbrella term for a dysfunctional involuntary nervous system

- POTS is a subcategory of autonomic dysfunction

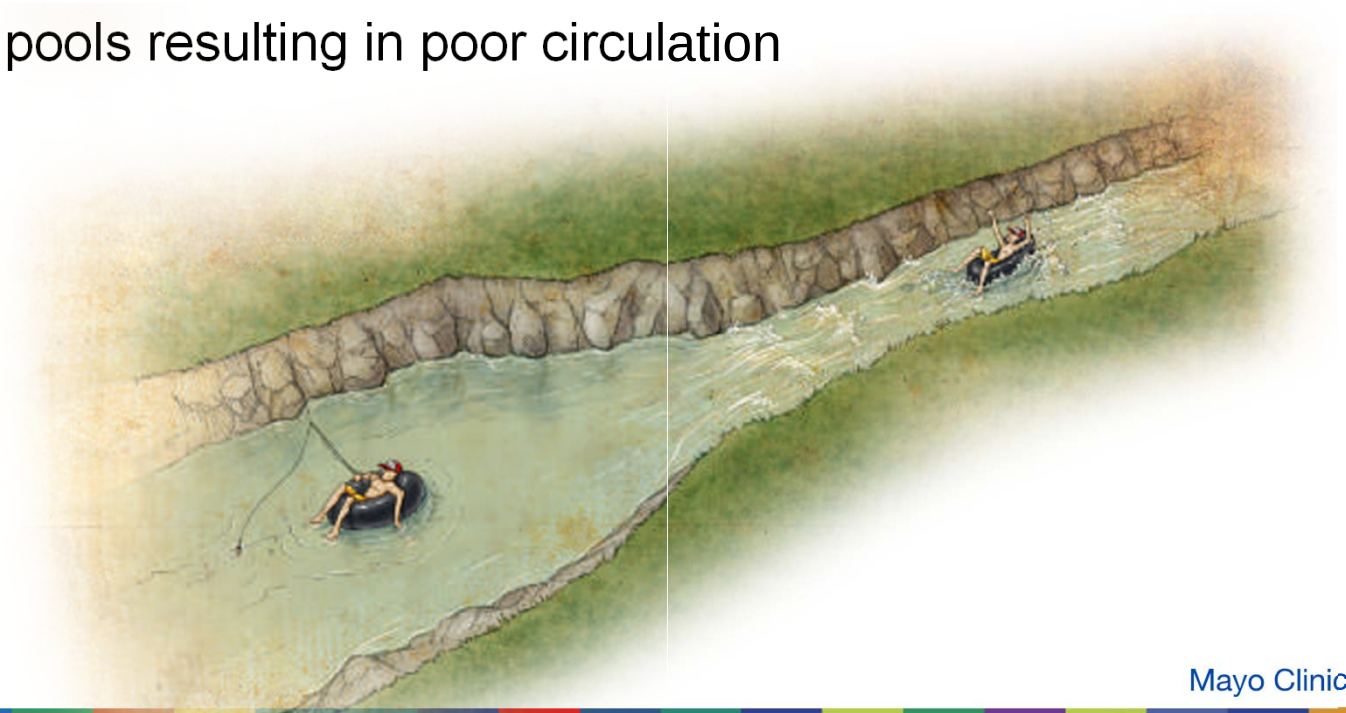
Postural Orthostatic Tachycardia Syndrome

- 67 % of adolescent chronic fatigue
- Often but not always overlaps with deconditioning

Burkhardt et al. *J Pediatr* 158:15, 2011

How should you describe POTS to your patient?

- Blood vessels relax & become wide
- Relaxed blood vessels are less efficient returning blood to heart when standing
- Blood pools resulting in poor circulation



Remember to Treat Identified Co-morbidities

- Life out of Balance
- Sleep Disorders
- Depression
- Other Diagnoses
- Iron Deficiency
- Hypovitaminosis D

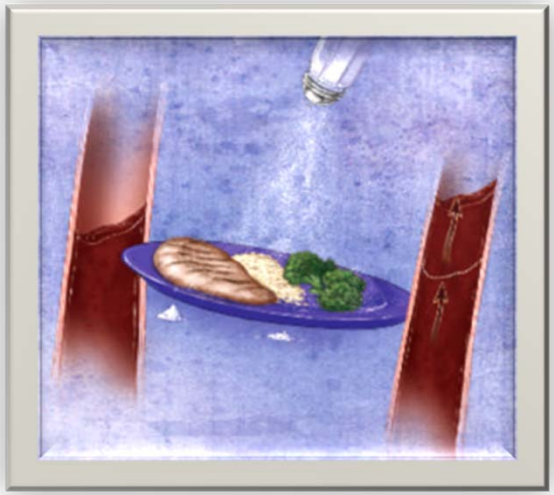
  400 – 2000 IU daily for months

STEPS Treatment Plan

- S alt
- T ake in fluids
- E xercise
- P rescriptions
- S leep,
  school, support system, safety

Salt

- Take in as much as taste buds can tolerate
- Good nutrition
  - 3 well balanced meals
  - 2 salty snacks
  - Meals should contain 3 items



*Salt helps the body keep the fluid in the blood vessels.

*Target 24-hour urine sodium of >170 mmol per day

Take in Fluids: 2-4 Liters of fluid daily (focus on majority of fluid as water)

Morning Routine

- Drink 8 ounces of a salty fluid (sports drinks, Nuun tablets, V-8, tomato juice) 10 minutes before getting out of bed
- Large muscle exercises (25 each)
  - Bicep curls
  - Squats
  - Heel raises
- Eat breakfast
  - Include protein

Exercise

- Overall movement goal - 60 minutes 7 days a week
- Break it down into cardio (aerobic) and “other physical activity” (helps with psychology of exercise)
  - 30 minutes cardio
  - 30 minutes other physical activity

- Exercise should make teen breathy & sweaty
- Give patients an exercise prescription (ie: Start with 5 min. brisk walking. Add 1-2 minutes every 2-4 days until up to goal of 30 minutes 7 days of week. Plus 30 minutes strength training 3 days/wk and 4 days/wk of yoga).

Exercise

enter

Prescription Medications

- Alpha Agonist

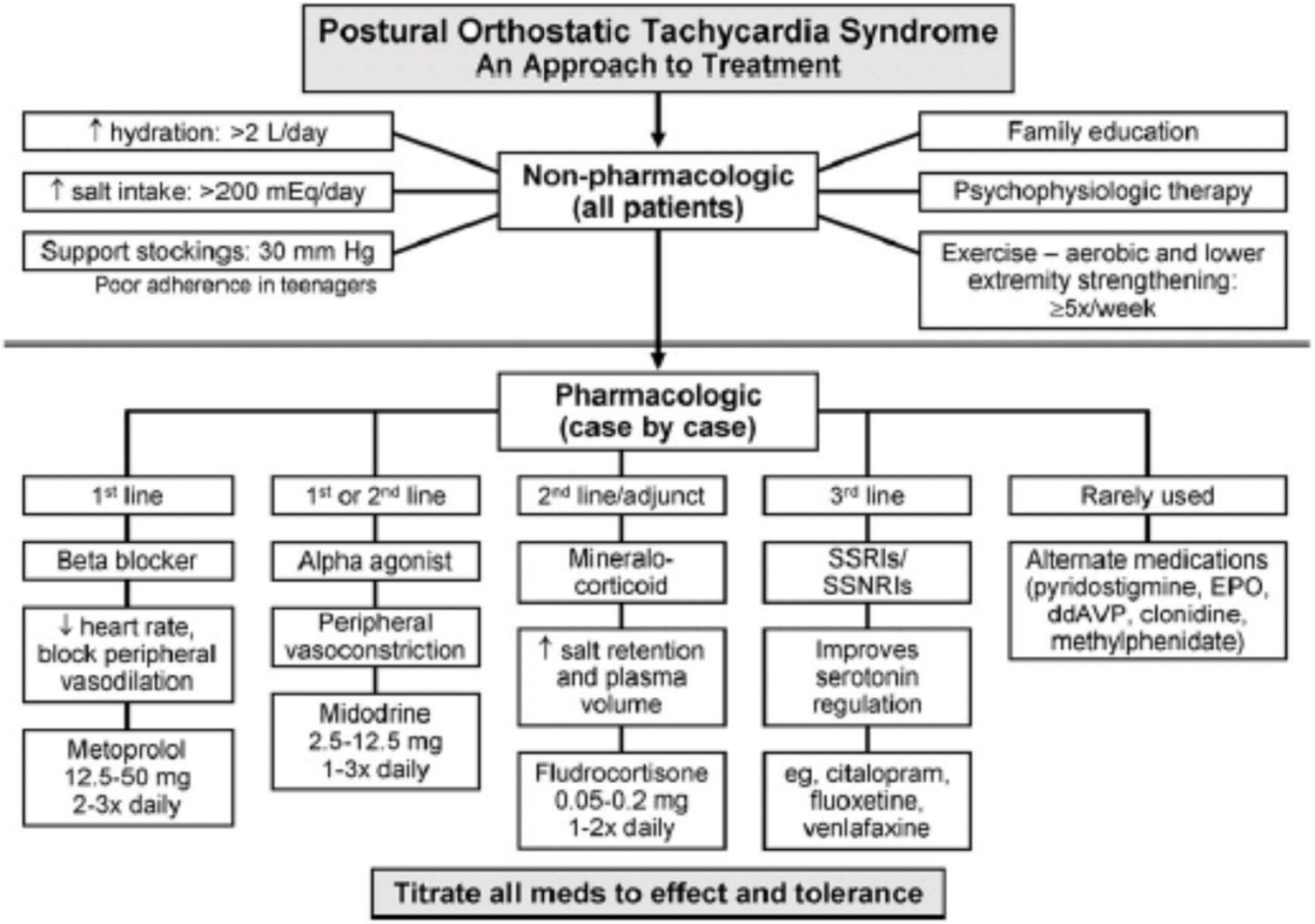
  -midodrine, 2.5 – 10 mg po TID

  -Pt must not lie down within 4 hours of taking due to risk of supine hypertension/HA

- Beta Blocker

  metoprolol tartrate, 25 mg po early morning & mid-day, possible 4 PM dose

- SSRI
- Florinef 0.1 mg daily
- Monitor BP carefully – don't want to cause med induced HTN



Pediatr Neurol 2010;42:77-85.

Adolescent Fatigue, POTS, and Recovery: A Guide for Clinicians

Sarah J. Kizilbash, MD, Shelley P. Ahrens, RN, CNP, DNP, Barbara K. Bruce, PhD, Gisela Chelimsky, MD, Sherilyn W. Driscoll, MD, Cynthia Harbeck-Weber, PhD, Robin M. Lloyd, MD, Kenneth J. Mack, MD, PhD, Dawn E. Nelson, RN, MSN, Nelly Ninis, MD, MSc, MBBS, Paolo T. Pianosi, MD, Julian M. Stewart, MD, PhD, Karen E. Weiss, PhD, and Philip R. Fischer, MD

Many teenagers who struggle with chronic fatigue have symptoms suggestive of autonomic dysfunction that may include lightheadedness, headaches, palpitations, nausea, and abdominal pain. Inadequate sleep habits and psychological conditions can contribute to fatigue, as can concurrent medical conditions. One type of autonomic dysfunction, postural orthostatic tachycardia syndrome, is increasingly being identified in adolescents with its constellation of fatigue, orthostatic intolerance, and excessive postural tachycardia (more than 40 beats/min). A family-based approach to care with support from a multidisciplinary team can diagnose, treat, educate, and encourage patients. Full recovery is possible with multi-faceted treatment. The daily treatment plan should consist of increased fluid and salt intake, aerobic exercise, and regular sleep and meal schedules; some medications can be helpful. Psychological support is critical and often includes biobehavioral strategies and cognitive–behavioral therapy to help with symptom management. More intensive recovery plans can be implemented when necessary.

Curr Probl Pediatr Adolesc Health Care 2014;44:108-133

Sleep

- Recommend 8.5-9.5 hours of sleep
- Many AAD patients struggle with sleep
- Tips
  - No cell phones in bedroom
  - Avoid caffeine
  - Bedtime routine
  - No Naps
  - No screen for 30-60 minutes before bed
  - Go to bed and get up at same time each day
  - Teens should use their beds for sleep only (not eating, doing homework, watching TV, etc)

School

- Go! It is important for teens with autonomic dysfunction to attend school regularly
- Assists with having a structured schedule and daily social time with friends
- Discontinue homebound schooling
- Create a return to school schedule

Support

- A good support system
  - Includes family, friends and school
- Good psychological support (cognitive behavioral therapy) helps teens to persevere/recover
- Deep diaphragmatic breathing, meditation, relaxation (ie: yoga, tai chi, etc), gratitude, biofeedback (Heartmath, Unyte, with a counselor or OT)
- Teen & parents must move out of illness behavior/lifestyle

[redacted]

Outcomes: POTS in Adolescents

THE JOURNAL OF PEDIATRICS • www.jpeds.com

ORIGINAL ARTICLES

Outcomes of Adolescent-Onset Postural Orthostatic Tachycardia Syndrome

Roma Bhatia, BS[1], Sarah J. Kizilbash, MD[1,2,*], Shelley P. Ahrens, DNP[1,2], Jill M. Killian, BS[1,3], Stephanie A. Kimmes, CNP[1,2], Erin E. Knoebel, MD[1,2], Prasuna Muppa, MBBS[1,2], Amy L. Weaver, MS[1,3], and Philip R. Fischer, MD[1,2]

Objectives To determine the clinical course of adolescent-onset postural orthostatic tachycardia syndrome (POTS) and to assess health-related quality of life, 2-10 years after diagnosis.

Study design Pediatric patients, 13-18 years of age, diagnosed with POTS at Mayo Clinic, Rochester, from 2003 to 2010 were mailed a questionnaire if they were at least 18 years of age at the time of the mailing. The primary outcome measures were norm-based, age- and sex-adjusted, 36-Item Short Form Health Survey physical composite score and mental composite score.

Results The survey was mailed to 502 patients with a response rate of 34% (n = 172). The mean duration from diagnosis to survey completion was 5.4 (SD, 1.9) years; the mean age of the respondents at the time of the survey was 21.8 (2.2) years. The responders were predominantly females (84% vs 68% of nonresponders; $P < .001$). Only 33 (19%) respondents reported complete resolution of symptoms, and an additional 51% reported persistent but improved symptoms, and 28 (16%) had only intermittent symptoms. The majority (71%) consider their health at least "good." The mean physical composite score was significantly lower than the population norm (mean [SD], 36.6 [15.8] vs 50; $P < .001$), however, the corresponding mean mental composite score was normal (50.1 [11.2]).

Conclusions Overall, 86% of adolescents with POTS report resolved, improved, or just intermittent symptoms, when assessed via questionnaire at an average of 5 years after initial treatment. Patients with persistent symptoms have more physical than mental health concerns. *(J Pediatr 2016;173:149-53).*

Mayo Clinic Children's Center

CASE 2: A 17 year old girl has POTS and pain. She is homebound and unable to become active with all your general and STEPS efforts.

What else can you do?

POTS and Pain – Persistent

Cognitive behavioral therapy works

Increasing exercise is better than “pacing”

McCrone et al. *PLOS One* 7:40808, 2012

A 3-week “rehab” program leads to lasting:

decreases in depression, anxiety, disability

decreases in dizziness, nausea

Bruce et al. American Autonomic Society, November 2012

Options to Speed Recovery

- Mayo Clinic 2 Day Pediatric Pain Rehabilitation Program
  - If missed less than 30 days school
- Mayo Clinic 3 Week Pediatric Pain Rehabilitation Program

After completion of the 2 Day PRC Program

- Hey this is !! So since I've been back I've been mostly walking and I'm up to 20 minutes. And 3 days a week I do PT for my activity and choose something random for the other days. I haven't missed a day yet. Honestly I feel a lot better and I went school shopping and I walked around for about 2 and a half hours straight(with a couple breaks but I didn't really have any problems)!! I haven't done that in over a year. The first day of school was yesterday and I made it the whole day today and yesterday without having to leave class for anything besides going to the bathroom. The hardest thing in school is sitting still because I'm dizzy when I sit still but today was better than yesterday(and it gets better when I use L1 hahaha) . Other than that it's ok and all of the teachers and staff are great. I'm glad I went to the Mayo Clinic when I did obviously because of the tips you guys gave me but also I heard a little bit of Dylan's story like how his POTs was bad like mine was and it's just great to see how much better he's gotten and I texted him a few weeks ago and he said he's still going to try football. That gave me a lot of hope about school and softball. Anyway thank you for everything 😄

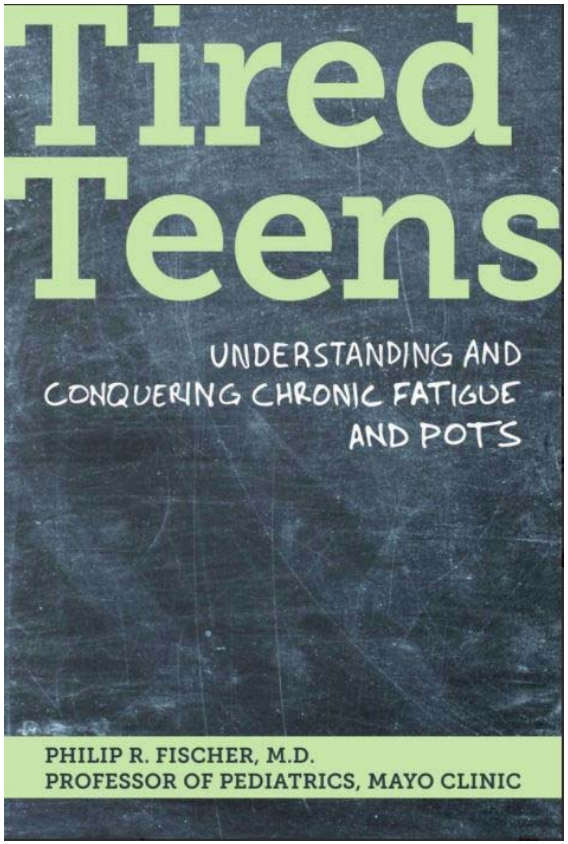
  Sent from my iPhone

POTS and Pain – Outcomes

I am just stunned at the difference in E since we have returned from Mayo's. She is exercising daily without prompting, following her regimen exactly, and is back to work and out and going places every day.

I could go on and on. It is just amazing and such a joy! If there is one thing I could pin it on, I believe that our trip to Mayo's gave E back HOPE!

Mother of “E” – a 14 year old with POTS and Pain


Tired Teens
UNDERSTANDING AND CONQUERING CHRONIC FATIGUE AND POTS
PHILIP R. FISCHER, M.D.
PROFESSOR OF PEDIATRICS, MAYO CLINIC

ahrens.shelley@mayo.edu

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