Adult Postural Orthostatic Tachycardia Syndrome (POTS)

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Disclosures

• Nothing to disclose (no financial or pharmaceutical affiliations)
• All discussed pharmacologic treatments are off-label

Objectives

• To tackle the heterogeneity and complexity of POTS by
  – Delineating the core mechanisms of the chief complaint: orthostatic intolerance
  – Considering other symptoms as manifestations co-morbidities (e.g. GI symptoms)
  – Describing the necessary multidisciplinary team (e.g. neurology, GI dysmotility clinic, geneticist, etc.).

Topics

• Terminology/Definition
• Epidemiology
• Pathophysiology/Etiology
• Clinical Features/H&P
• Diagnosis/Testing
• Treatment/Management
• Prognosis

Definition/Terminology

• POTS: postural tachycardia without OH
  – 1982: Postural Tachycardia Syndrome
  – 1993: Postural Orthostatic Tachycardia Syndrome
• Nosology of POTS is confusing due to several terms in the past
• Debilitating disorder

Epidemiology

• Most common syndrome on young people in autonomic dysfunction clinics
• Estimates
  – Prevalence: > 170 per 100,000 (underdiagnosis)
  – Over 500,000 Americans, primarily young woman (1999)
• Age: 14-45 years
• F/M ratio: 5:1

Postural Orthostatic Tachycardia Syndrome

- Symptoms occur in association with an inappropriate rise in heart rate in the absence of a fall in blood pressure with the assumption of standing
- The pathophysiology of POTS is complicated and poorly understood

Complexity

- Heterogeneous nature of POTS
- Challenging for researchers to design an appropriate cell or animal model
- Mechanisms underlying POTS are still being elucidated

Etiology

- Distal denervation
  - Post-viral
- Hypovolemia (fluid expansion)
- Changes in venous function (military anti-shock trousers)
  - Decreased venous return
  - Decreased stroke volume on assuming upright posture
  - Excessive venous pooling
- Cardiovascular deconditioning
  - Reduced maximum oxygen uptake during exercise
  - Small left ventricular size
- Increased sympathetic activity
- Hyperventilation
- Genetic abnormalities
- 12% positive FH
- Associated disorders
  - Ehlers-Danlos syndrome (EDS)

Hypovolemia in POTS

- Low blood volume (red cell volume and plasma volume) has been demonstrated in multiple studies in POTS patients (Jacob et al., 1997; Raj et al., 2005a; Stewart et al., 2006a; Fu et al., 2010).
- Some studies have reported reduced blood volume including red cell and plasma volume in POTS (Raj et al., 2005; Stewart et al., 2006).

Bar graphs show effects of medical interventions on changes in orthostatic hemodynamics in IOT patients. SBP, DBP, and HR are compared for measurements taken with the patients supine and after 3 minutes of standing before and then 1 and 2 hours after the administration of placebo, midodrine, or clonidine, or 1 hour after normal saline infusion.
Venous pooling in POTS


Cardiac Origins of the POTS (n=27)

- HR increase from recumbent to standing position
- > 30 bpm
- > 40 bpm if younger than 19 years
- Provocative actions trigger a cascade of symptoms

Clinical Features

Orthostatic Symptoms

- Brain hypoperfusion
  - Dizziness, lightheadedness, weakness, blurred vision, fatigue upon standing
  - Cerebral hypoperfusion despite normal systemic blood pressure? (no evidence)
- Sympathetic activation
  - Palpitations, tremulousness, anxiety

Clinical Features

- Onset
  - Abrupt
  - Insidious
- Severity
  - Mild
  - Profoundly incapacitated
- Course
  - Self-limited
  - Relapsing-remitting over several years
Dependent Acrocyanosis in POTS

Diagnosis

• Exaggerated increase in heart rate on tilt table testing or standing
• Sustained 30 bpm within the first 10 minutes of tilt

Differential Diagnosis

• Autonomic neuropathies?
• Bed rest deconditioning
• Dehydration
• Panic, anxiety, somatization disorder, chronic fatigue

Management

• POTS has multiple symptoms and causes
• A multidisciplinary management approach including a graded exercise program is recommended (Fu et al., 2011; Sheldon et al., 2015)
• Maintenance of intravascular volume by increasing salt and fluid intake is generally recommended (Sheldon et al., 2015)
• Improve intravascular volume, blunt tachycardia, improve venous return or reduce central sympathetic outflow, however most therapies used to date are without a large body of evidence, (Sheldon et al., 2015)
• The development of target therapies has been hindered by a lack of a unifying mechanism
Treatment of POTS

- Optimize circulation
  - Tanking up (hypovolemia)
  - Squeezing up (venous pooling)
- Exercise (deconditioning)
- Adapt to limitations

Treatment (Hypovolemia)

- Non-pharmacologic
  - Fluids: > 64 oz/day
  - Increase dietary salt intake (fluid retainer)
  - Salt tabs, 3-6 tabs a day (fluid retainer)
  - Drink 2 large electrolyte fluids with 1 teaspoon added salt/day
- Pharmacologic
  - Fludrocortisone (0.05-0.2 mg/d) (salt retainer)

Treatment (Venous pooling)

- Physical compression:
  - Compression stockings, 30-40 mmHg, knee high (when up and about, off when laying down)
  - Physical countermaneuvers
- Pharmacologic compression
  - Midodrine 2.5-10 mg 3 x day (Gordon et al., 2000)
  - Pyridostigmine 30 mg/day (Raj et al., 2009; Kanjwal et al., 2011)
  - Droxidopa 100 mg 3 x day (Ruzieh et al., 2016)

Treatment (Hyperadrenergic State)

- Troubled adrenergic symptoms (palpitations)
  - Propranolol 20-30 mg 3 x day
  - Sinus node ablation is not effective

Treatment (Deconditioning)

Aquatherapy prescription: gradual gentle water jogging and/or swimming

Exercise is the most important treatment (as important as any medication). Regular exercise is the only treatment that has long-term benefit. Cardiac remodeling may include: water jogging, water rowing, reclining bike, etc. To start from a gentle water jogging program or swimming, for example before transitioning to land in a reclining or sitting position (rowing, reclining bike, etc.). Start at 10-15 minutes 2 times per week, and gradually build up over 6 months until you are at 45 minutes 2 times per week. You may need a physical therapy appointment or exercise trainer to help you. Avoid reaching the point of shortness of breath, profuse sweating or exhaustion during an exercise session. If exercise session results in extreme fatigue for the next couple of days, reduce duration of session and intensity of training. Rest at least one day between sessions early in the process. Drink fluids prior and during exercise. Above is a chart heart rate in beats per minute for each intensity zone.

Exercise in POTS

- Short-term (i.e., 3 months) exercise training increases cardiac size and mass, blood volume, and VO2 peak in POTS patients.
- The tachycardia in POTS is due to a reduced stroke volume. Cardiac remodeling and blood volume expansion associated with exercise training increase physical fitness and improve exercise performance in these patients

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Life Adjustments in POTS

- Avoid overdoing it (do not “hit a wall”)
- Listen to your body
- Pace yourself
- Scheduled breaks
- Distribute limited energy
- If feeling great, “hold your horses”
- Incorporate exercise as part of your life
- Education of support network

PROGNOSIS

- Most patients have a favorable prognosis

Take Home Points

- Simultaneous physiologic approach to optimize circulation
  - Hypovolemia: tank your patient up
  - Venous Pooling: squeeze patient up
  - Deconditioning: graded exercise through PT
  - Judicious use of energy
- Multidisciplinary team approach
  - Autonomic Neurology: orthostatic intolerance
  - Comorbidities: appropriate referrals
    - Migraines: Headache specialists/general neurology
    - Fibromyalgia: PM&R
    - Intestinal cystitis: Urology
    - Inappropriate sinus tachycardia: Cardiac Electrophysiology
  - Joint hypermobility: Adult Genetic Clinic r/o EDS

Bibliography