Multi-Faceted Nature of Postural Tachycardia Syndrome (POTS)

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Heart Rhythm Congress (Birmingham, UK)
October 1 2017
Postural Tachycardia Syndrome
- Common Criteria

- Orthostatic tachycardia ≥30 bpm
  - ≥40 bpm required if <18 years

- No consistent orthostatic hypotension
  - ΔBP ≥20/10 mmHg

- Orthostatic Symptoms
  - Worse upright; better recumbent
  - Some due to sympathetic activation?

- Chronic symptoms ≥6 months
POTS - Common Symptoms

Cardiac
- Rapid Heartbeat
- Chest Discomfort
- Short of Breath
- Lightheaded
- Exercise Intolerance

Non-Cardiac
- Mental Clouding
- Headache
- Nausea
- Tremulousness
- Fatigue
- Sleep Complaints
Tilt Testing

POTS

Control

Heart Rate (bpm)

Blood Pressure (mmHg)

Tilt Angle (deg)

SR Raj, Indian Pacing Electrophysiol J. 2006;6:84-99
POTS: Feel awful when upright

SR Raj & RS Sheldon, *Tilt Table Testing* in
POTS – Who is affected?

- Prevalence $\frac{1}{2}$-3 million in USA
- Female (~80-85%)
- Typically aged 13-50 years
  - “women of child-bearing age”
- Significant functional disability
Is POTS ... a Psychiatric Disorder?

Vidya Raj
Patients with POTS did not have an increased prevalence of major depression or anxiety disorders, including panic disorder, compared to the general population.
CAARS DSM-IV Inattention Scores

ANOVA P<0.001
N vs. P: P=0.001
N vs. A: P<0.001
P vs. A: P=0.001
P vs. B: P=0.008

V Raj et al., J Neurol Neurosurg Psychiatry 2009; 80: 339-344
Anxiety (ASI) Scores

- Total score 0-64
- Population 19.1±9.1
- Panic disorder 36.4±10.3
- POTS vs. pop: P=0.07
- ADHD vs. pop: P=0.001

ANOVA P<0.001
N vs. P: P=0.001
N vs. A: P=0.031
P vs. A: P=0.504

V Raj et al., J Neurol Neurosurg Psychiatry 2009; 80: 339-344
Is the HR Increase in POTS due to Blood Pooling in Legs or Anxiety?
Quality of Life in POTS

Kanika Bagai
Health Related Quality of Life (SF-36) – Chronic Illnesses

SF36 Sub-Scores

Score

Back Pain
Dialysis

Physical
Mental

SF36 Sub-Scores
Health Related Quality of Life (SF-36) – Chronic Illnesses

- POTS
- Back Pain
- Dialysis

Modified from K Bagai et al., J Clin Sleep Med 2011
WHY do they have POTS?

... ‘final common pathway’ of hundreds of genetic and acquired autonomic and cardiovascular entities

- David Robertson
POTS - Pathophysiology

- Mast Cell Activation
- Partial Autonomic Neuropathy
- Leg Blood Flow Abnormalities
- Hypovolemia
- Hyperadrenergic
  - Increased Release
  - Decreased Clearance
- Antibodies are Evil...
A Norepinephrine Synapse

Slide courtesy of Alex Nackenoff (Vanderbilt)
Norepinephrine Synapse – NET blocked

Slide courtesy of Alex Nackenoff (Vanderbilt)
POTS – What to Do?

Investigation & Treatment
POTS: Treatment Approaches

- **Exercise**

- **Increase Blood Volume**
  - Oral Water
  - Increase Salt (diet vs. tablets)
  - Fludrocortisone
  - Octreotide
  - IV Saline
  - Acute DDAVP-H₂O

- **Hemodynamic Agents**
  - Midodrine
  - Propranolol
  - Pyridostigmine
  - Ivabradine (emerging)

- **Behavioral Therapies**
Exercise in POTS - Benefits

- Short-term exercise training in POTS
  - Increases fitness levels
  - Increases blood volume
  - Cardiac Remodeling
  - Normalizes Sympathetic Activity

- Decreases Orthostatic Tachycardia
- Improves Quality of Life

Qi Fu et al., JACC 2010;55:2858-68
Exercise in POTS – How To?

- Focus on Aerobic Activity
  - Some resistance training focused on thighs
- Must be Regular
  - Every other day (4/week)
- 30min/session -> 45-60min/session
- NO UPRIGHT EXERCISES
  - Rowing machines
  - Recumbent Cycles
  - Swimming
- Takes 4-5 weeks to start seeing benefits

Qi Fu et al., JACC 2010;55:2858-68
POTS: Treatment Approaches

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  - Oral Water
  - Increase Salt (diet vs. tablets) – data coming
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- Behavioral Therapies
- Treat Co-Morbidities
IV Saline (1L) Acutely Decreases Orthostatic Tachycardia...a LOT!!

G Jacob et al. Circulation 1997;96:575-580
DDAVP+H₂O reduces standing HR

ST Coffin et al., Heart Rhythm. 2012;9:1484-90
POTS: Treatment Approaches

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Midodrine Decreases Orthostatic Tachycardia...a little bit.
Propranolol 20mg lowers Orthostatic Tachycardia

SR Raj et al. Circulation 2009;120:725-734
Propranolol Improves Symptoms...

Symptoms

- Propranolol
- Placebo

Symptoms (a.u.)

<table>
<thead>
<tr>
<th>Time Post Dose</th>
<th>Propranolol</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>2H</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>4H</td>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

$P_{int} = 0.04$

SR Raj et al. Circulation 2009;120:725-734
...but Less is More

SR Raj et al. Circulation 2009;120:725-734
Norepinephrine Transporter Inhibition (e.g. SNRI drugs)

EA Green et al., JAH 2013;2:e000395
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POTS – Take Home Messages

- **POTS**
  - chronic disorder associated with significant disability
  - Syndrome...not one disease
    - Multiple pathophysiologies

- **Treatment**
  - Exercise
  - Volume expansion
  - Heart rate control
  - Manage the “living with a chronic illness”
Questions?