Introduction to Autonomic Disorders in the Clinic

Glen A. Cook, M.D.
LCDR, MC, USN
Department of Neurology,
Walter Reed National Military Medical Center
Assistant Professor, USUHS
Bethesda, MD

FOMA Mid-Year Seminar
September 15th, 2018
Disclaimers & Disclosures

• The views expressed in this presentation are those of the author/speaker and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.

• I am a military service member. This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that “Copyright protection under this title is not available for any work of the United States Government.” Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person’s official duties.

• This presentation contains data from research derived from approved Naval Medical Center Portsmouth, Virginia, IRB protocols; numbers NMCP.2017.0054 and NMCP.2016.0035.

• I have no relevant financial disclosures pertinent to this presentation.
Objectives

Participants will:

- Understand the components of the autonomic nervous system (ANS)
- Recognize presenting symptoms of autonomic dysfunction
- Appreciate the cross-disciplinary nature of disorders of the ANS
- Understand first-line clinical and laboratory tests to evaluate and confirm disorders of the ANS
• Acknowledgements
  – David S. Goldstein, MD, PhD – *Principles of Autonomic Medicine, v. 2*
Disease burden

- **Syncope:**
  - Lifetime prevalence: ~27%
  - First-ever syncope incidence 6.2/1000 person years (da Silva, Front Physiol. 2014)

- **Postural tachycardia syndrome (POTS):**
  - Incidence: 500,000-3 million in the U.S. (0.2-1%)

- **Irritable bowel syndrome:**
  - Prevalence: 16.7–24.2%

- **Parkinson disease with orthostatic hypotension (OH):**
  - 18% of PD patients (Ha et al. Parkinsonism Relat Disord. 2011)

- **Multiple system atrophy (MSA):**
  - Prevalence: 3.4-4.9 cases per 100,000 (~0.00004%)
  - Incidence: 0.6-0.7 cases per 100,000 person-years (Fanciulli et al. NEJM 2015; Stefanova et al. Lancet Neurol. 2009)

- **Pure autonomic failure (PAF):** Prevalence: 1-9/100,000 (~0.00005%)

- **HSAN III:** ~300 currently worldwide
Breast cancer
POTS
PD
Multiple Sclerosis
COPD
IBS
Syncope
Time to diagnosis

- POTS: 5 years 11 months $\rightarrow$ 4 years 2 months (2016)

- MSA: $\sim$6 years

Average number of doctors seen prior to diagnosis: 7.3
The “automatic” nervous system

D.S. Goldstein, public domain
Central nervous system

Brain & spinal cord

Peripheral nervous system

Nerve root, nerves, and synapses
Ganglionic Neurotransmission

Medulla

Cranial

Spinal Cord

Thoracolumbar

Sacral

Vagus Nerve

Ganglion

Cardiac Nerve

Splanchnic Nerve

Pelvic Nerve

Acetylcholine

Norepinephrine

Adrenaline

D.S. Goldstein, public domain
<table>
<thead>
<tr>
<th>Autonomic system</th>
<th>Responsible for...</th>
<th>Lesion causes...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympathetic noradrenergic</td>
<td>Vasomotor tone, heart rate</td>
<td>Neurogenic orthostatic hypotension, ptosis</td>
</tr>
<tr>
<td>Sympathetic cholinergic</td>
<td>Sweating</td>
<td>Anhidrosis</td>
</tr>
<tr>
<td>Sympathetic adrenergic</td>
<td>Promoting glycogenolysis; skeletal muscle blood flow during stress response</td>
<td>?prolonged hypoglycemia; ?decreased muscle performance during strenuous activity</td>
</tr>
<tr>
<td>Parasympathetic</td>
<td>Lots (&quot;stuff you do behind closed doors&quot;)</td>
<td>Dry mouth, constipation, urinary retention, sexual arousal</td>
</tr>
<tr>
<td>Enteric</td>
<td>GI motility, etc.</td>
<td>Early satiety, abnormal medication absorption, constipation</td>
</tr>
</tbody>
</table>
Syncope

Kupang, Indonesia (Aug. 23, 2006) - U.S. Navy Cmdr. Elizabeth Satter assists an elderly woman who fainted due to the heat while waiting among the large crowds of people waiting to be seen by members of from the Military Sealift Command (MSC) hospital ship, USNS Mercy (T-AH 19) providing free care during a medical and dental care civil action project.

Syncope (cont.)

- Cardiogenic syncope
  - Structural
  - Bradyarrhythmia
  - Tachyarrhythmia
- Orthostatic hypotension
  - Hypovolemia
  - Medication-induced
  - Neurogenic
- Reflex syncope
  - Vasovagal (aka neurocardiogenic, neurally-mediated)
  - Situational syncope
  - Carotid sinus hypersensitivity
- Other (subclavian steal, CNS lesion)

Drop in SBP of >20 mmHg or drop in DBP of >10 mmHg within 3 minutes of standing
Neurogenic OH and the Baroreflex


Copyrighted image. Used with permission
Postural tachycardia syndrome

- 500,000 – 3 million people in U.S.
- Average diagnostic delay: 4 years, 2 months
- Average number of doctors seen prior to diagnosis: 7.3
  (BIG POTS Survey. Data presented at Dysautonomia International annual conference, July 2017)

- Orthostatic intolerance
- Exaggerated orthostatic tachycardia (>30 bpm increase; >40 bpm increase if <18 years old)
Clinic Statistics

215 patients

- POTS: [VALUE] (32%)
- Other: [VALUE] (68%)

- SFN: 86 (40%)
- No SFN: 129 (60%)
SFN in POTS

POTS no SFN: [VALUE] (46%)
POTS + SFN: [VALUE] (54%)
Testing the ANS

- History
- History
- History
- Physical exam
<table>
<thead>
<tr>
<th>Autonomic system</th>
<th>Responsible for...</th>
<th>Lesion causes...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympathetic noradrenergic</td>
<td>Vasomotor tone, heart rate</td>
<td>Neurogenic orthostatic hypotension, ptosis</td>
</tr>
<tr>
<td>Sympathetic cholinergic</td>
<td>Sweating</td>
<td>Anhidrosis</td>
</tr>
<tr>
<td>Sympathetic adrenergic</td>
<td>Promoting glycogenolysis; skeletal muscle blood flow during stress response</td>
<td>?prolonged hypoglycemia; ?decreased muscle performance during strenuous activity</td>
</tr>
<tr>
<td>Parasympathetic</td>
<td>Lots (“stuff you do behind closed doors”)</td>
<td>Dry mouth, constipation, urinary retention, sexual arousal</td>
</tr>
<tr>
<td>Enteric</td>
<td>GI motility, etc.</td>
<td>Early satiety, abnormal medication absorption, constipation</td>
</tr>
</tbody>
</table>
Testing the ANS (cont.)

http://www.cnsystems.com/products/task-force-monitor
Sympathetic cholinergic (sudomotor) testing

Quantitative Sudomotor Axon Reflex Test (QSART) (QSWEAT)
Thermoregulatory Sweat Test (TST)
Others (QDIRT, etc.)
Bedside evaluation of sudomotor function

• “Spoon” test
• Skin exam under magnification
• The sock test
Cardiovagal testing (parasympathetic)
HRDB – Normal example

Test ID: 1223
Date: 09/09/2013 21:03
Remarks:

Analysis ID: 1709
Date: 09/09/2013 22:47
Comments:

HRDB Analysis
Analyst: Mark E Landau, MD

Test Data

<table>
<thead>
<tr>
<th>Max Rate</th>
<th>Min Rate</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.6</td>
<td>53.8</td>
<td>14.8</td>
</tr>
<tr>
<td>69.0</td>
<td>53.6</td>
<td>15.4</td>
</tr>
<tr>
<td>69.8</td>
<td>54.3</td>
<td>15.5</td>
</tr>
<tr>
<td>71.4</td>
<td>54.3</td>
<td>17.1</td>
</tr>
<tr>
<td>68.2</td>
<td>55.3</td>
<td>12.9</td>
</tr>
</tbody>
</table>

Analysis Summary

Average HR Difference: 15.1
Comparison Range: n/a
Norms Table: n/a

Norms not available for this modality.

Marker Time Annotation

3:15.00 start
4:35.50 stop
7:57.50 stop
Diminished HRDB

**Analysis ID:** 2569  
**Date:** 05/18/2015 10:33  
**Analyst:** Glen Cook, MD

**Comments:** Normal heart rate response to deep breathing compared to age-matched norms.

### Test Data

<table>
<thead>
<tr>
<th>Max Rate</th>
<th>Min Rate</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.9</td>
<td>67.0</td>
<td>9.9</td>
</tr>
<tr>
<td>78.4</td>
<td>67.0</td>
<td>11.4</td>
</tr>
<tr>
<td>75.9</td>
<td>66.7</td>
<td>9.3</td>
</tr>
<tr>
<td>78.4</td>
<td>67.8</td>
<td>10.6</td>
</tr>
<tr>
<td>76.9</td>
<td>66.3</td>
<td>10.6</td>
</tr>
</tbody>
</table>

### Analysis Summary

- **Average HR Difference:** 10.4
- **Comparison Range:** n/a
- **Norms Table:** n/a

Norms not available for this modality.

**Marker Time Annotation**

- 0:46.50 start
- 2:07.00 stop
- 4:28.50 start

![Heart Rate Graph](image)
Orthostatic Hypotension

Tilt Analysis
Analysis ID: 2671
Date: 05/18/2015 10:44
Analyst: Glen Cook, MD

Comments: There was orthostatic hypotension. The chronotropic response was minimal.

Test Data - Recorded

<table>
<thead>
<tr>
<th>Time</th>
<th>SBP</th>
<th>DBP</th>
<th>HR</th>
<th>Δ SBP</th>
<th>Δ DBP</th>
<th>Δ HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>153.2</td>
<td>67.7</td>
<td>59.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>102.4</td>
<td>66.4</td>
<td>64.0</td>
<td>-50.8</td>
<td>-1.3</td>
<td>4.3</td>
</tr>
<tr>
<td>3.0</td>
<td>133.6</td>
<td>84.1</td>
<td>69.4</td>
<td>-19.6</td>
<td>16.4</td>
<td>9.8</td>
</tr>
<tr>
<td>5.0</td>
<td>133.5</td>
<td>83.9</td>
<td>70.0</td>
<td>-19.7</td>
<td>16.1</td>
<td>10.3</td>
</tr>
<tr>
<td>10.0</td>
<td>129.0</td>
<td>88.4</td>
<td>78.2</td>
<td>-24.2</td>
<td>20.7</td>
<td>16.5</td>
</tr>
<tr>
<td>Post</td>
<td>149.2</td>
<td>92.7</td>
<td>60.9</td>
<td>-4.0</td>
<td>25.0</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Analysis Summary

- Minimum SBP 100.9 at 1.2 minutes
- SBP Change -52.3
- HR at min SBP 63.2
- Maximum HR 75.5 at 4.4 minutes
- Minimum HR 59.1 at 0.1 minutes
- HR Delta 16.4

Marker Time Annotation
3:58.00 tilt
14:01.50 down

Heart Rate (Beats/Min)

Blood Pressure (mmHg)
Orthostatic hypotension (cont.)

**Tilt Analysis**

Analysis ID: 2571  
Date: 05/18/2015 10:44  
Analyst: Glen Cook, MD

Comments: There was orthostatic hypotension. The chronotropic response was minimal.

<table>
<thead>
<tr>
<th>Time</th>
<th>SBP</th>
<th>DBP</th>
<th>HR</th>
<th>Δ SBP</th>
<th>Δ DBP</th>
<th>Δ HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>153.2</td>
<td>67.7</td>
<td>59.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>102.4</td>
<td>66.4</td>
<td>64.0</td>
<td>-50.8</td>
<td>-1.3</td>
<td>4.3</td>
</tr>
<tr>
<td>3.0</td>
<td>133.6</td>
<td>84.1</td>
<td>69.4</td>
<td>-19.6</td>
<td>16.4</td>
<td>9.8</td>
</tr>
<tr>
<td>5.0</td>
<td>133.5</td>
<td>83.9</td>
<td>70.0</td>
<td>-19.7</td>
<td>16.1</td>
<td>10.3</td>
</tr>
<tr>
<td>10.0</td>
<td>129.0</td>
<td>88.4</td>
<td>76.2</td>
<td>-24.2</td>
<td>20.7</td>
<td>16.5</td>
</tr>
<tr>
<td>Post</td>
<td>149.2</td>
<td>92.7</td>
<td>60.9</td>
<td>-4.0</td>
<td>25.0</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Analysis Summary**

- Minimum SBP 100.9 at 1.2 minutes
- SBP Change -52.3
- HR at min SBP 63.2
- Maximum HR 75.5 at 4.4 minutes
- Minimum HR 59.1 at 0.1 minutes
- HR Delta 16.4

**Marker Time Annotation**

3:58.00 tilt
14:01.50 down
Orthostatic hypotension (cont.)

Tilt Analysis

Analysis ID: 2571  Date: 05/18/2015 10:44  Analyst: Glen Cook, MD
Comments: There was orthostatic hypotension. The chronotropic response was minimal.
Orthostatic Hypotension (cont.)

### Tilt Analysis

**Analysis ID:** 2571  
**Date:** 05/18/2015 10:44  
**Comments:** There was orthostatic hypotension. The chronotropic response was minimal.

### Test Data - Recorded

<table>
<thead>
<tr>
<th>Time</th>
<th>SBP</th>
<th>DBP</th>
<th>HR</th>
<th>Δ SBP</th>
<th>Δ DBP</th>
<th>Δ HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>153.2</td>
<td>67.7</td>
<td>59.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>102.4</td>
<td>66.4</td>
<td>64.0</td>
<td>-50.8</td>
<td>-1.3</td>
<td>4.3</td>
</tr>
<tr>
<td>3.0</td>
<td>133.6</td>
<td>84.1</td>
<td>69.4</td>
<td>-19.6</td>
<td>16.4</td>
<td>9.8</td>
</tr>
<tr>
<td>5.0</td>
<td>133.5</td>
<td>83.9</td>
<td>70.0</td>
<td>-19.7</td>
<td>16.1</td>
<td>10.3</td>
</tr>
<tr>
<td>10.0</td>
<td>129.0</td>
<td>88.4</td>
<td>76.2</td>
<td>-24.2</td>
<td>20.7</td>
<td>16.5</td>
</tr>
<tr>
<td>Post</td>
<td>149.2</td>
<td>92.7</td>
<td>60.9</td>
<td>-4.0</td>
<td>25.0</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Neurogenic OH

- Information about BP doesn’t get to the brain
- Brainstem doesn’t sense BP change
- Sympathetic nerves don’t carry signal appropriately
- Nerve signal is not communicated between nerves or between nerve and blood vessel

Other causes of OH

- Low blood volume
- Adrenocortical failure
- Vasodilatory substances
- Medications
- Medications
- Medications
The Baroreflex


Copyrighted image. Used with permission
Neurogenic OH

- Information about BP doesn’t get to the brain
- Brainstem doesn’t sense BP change
- Sympathetic nerves don’t carry signal appropriately
- Nerve signal is not communicated between nerves or between nerve and blood vessel

Other causes of OH

- Low blood volume
- Adrenocortical failure
- Vasodilatory substances
- Medications
- Medications
- Medications
Valsalva Maneuver

Heart Rate
bpm

Control

Blood Pressure
mm Hg

Valsalva

Control

Sympathetic Neurocirculatory Failure

Adapted from D. Goldstein
Other tests of autonomic function

• Gastric emptying studies
• Colonic motility studies
• Urodynamic testing
• Ambulatory blood pressure monitoring
Clinical evaluation – “the workup”
POTS

- Deconditioning
- Hypovolemia
- NE reuptake
- Arterial tone
- Venous tone

\[ \downarrow \text{Cardiac output} \]

\[ \beta\text{-receptor hypersensitivity} \]

\[ \uparrow \text{Adrenomedullary output} \]

\[ \downarrow \text{Arterial tone} \]

\[ \downarrow \text{Venous tone} \]

Centrally \[ \uparrow \text{NE output} \]
POTS

Deconditioning

Venous tone

Arterial tone

Centrally ↑ NE output

β-receptor hypersensitivity

Cardiac output

Hypovolemia

Fluid extravasation

Renal volume loss

Hypovolemia

↓ NE reuptake

? Deconditioning

↓ NE production or release

Autonomic neuropathy

↓ Arterial tone

Estrogen

↓ Venous tone

α-1 adrenoreceptor blockade

Ganglionic blockade

Release of vasodilatory mediators (mastocytosis, carcinoid syndrome)

Chronic sleep deprivation

Psychobehavioral

Progesterone

EDS/other collagen abnl?

Release of vasodilatory mediators (mastocytosis, carcinoid syndrome)

Chronic inflammation

Renal volume loss

Hypovolemia

Fluid extravasation

↓ Cardiac output

β-receptor hypersensitivity

Centrally ↑ NE output

↑ Adrenomedullary output

↑ Adrenomedullary output

↓ NE production or release

α-1 adrenoreceptor blockade

Ganglionic blockade

Release of vasodilatory mediators (mastocytosis, carcinoid syndrome)
Clinical evaluation – “the workup”

• Check orthostatic vital signs
• For recurrent syncope or tachycardia: cardiac screening including ECG, echocardiogram, prolonged rhythm monitoring
• For orthostatic intolerance: check morning cortisol
• For small fiber neuropathies: screen for autoimmune disorders, diabetes, alcohol use, etc.
Adrenal insufficiency: 5/215 (2.3%)
<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Diagnosis</th>
<th>Secondary diagnoses</th>
<th>POTS (0/1)</th>
<th>OH (0/1)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>f</td>
<td>Syncope</td>
<td>Hypopituitarism</td>
<td>0</td>
<td>1</td>
<td>Referred for POTS; acromegaly + infertility; found to have a pituitary adenoma</td>
</tr>
<tr>
<td>45</td>
<td>f</td>
<td>Adrenal failure</td>
<td></td>
<td>0</td>
<td>1</td>
<td>Referred for POTS; Pituitary adenoma</td>
</tr>
<tr>
<td>31</td>
<td>m</td>
<td>OH</td>
<td>Adrenal failure</td>
<td>0</td>
<td>1</td>
<td>Transient adrenal insufficiency with normal ACTH. Recovery tracked with symptom improvement. Cortisol normal by time ACTH stim was done</td>
</tr>
<tr>
<td>48</td>
<td>f</td>
<td>Adrenal failure</td>
<td>SFN</td>
<td>0</td>
<td>1</td>
<td>Post-infectious autonomic neuropathy in 2015 also found to have secondary adrenal insufficiency with pituitary adenoma</td>
</tr>
<tr>
<td>46</td>
<td>f</td>
<td>Adrenal failure</td>
<td>Autoimmune urticaria</td>
<td>0</td>
<td>0</td>
<td>Normal brain imaging; stim test pending</td>
</tr>
</tbody>
</table>
Clinical evaluation – “the workup”

• Check orthostatic vital signs
• For recurrent syncope or tachycardia: cardiac screening including ECG, echocardiogram, prolonged rhythm monitoring
• For orthostatic intolerance: check morning cortisol
• For small fiber neuropathies: screen for autoimmune disorders, diabetes, alcohol use, etc.
11 of POTS + SFN classified as possible or probable autoimmune (29.7%)
SFN in POTS

2 of POTS no SFN classified as possible or probable autoimmune (6.5%)
## Autoimmune diagnoses in neuropathic POTS

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>What autoimmune dx?</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>f</td>
<td>Sjogren's + antiphospholipid syndrome</td>
</tr>
<tr>
<td>30</td>
<td>f</td>
<td>Unspecified, subacute, progressive, IVIG responsive</td>
</tr>
<tr>
<td>31</td>
<td>f</td>
<td>SLE</td>
</tr>
<tr>
<td>22</td>
<td>f</td>
<td>Behcet's</td>
</tr>
<tr>
<td>22</td>
<td>f</td>
<td>Post-infectious (prolonged URI) and post-vaccinial</td>
</tr>
<tr>
<td>30</td>
<td>m</td>
<td>Post-infectious (facial rash, sinusitis; got better with prednisone)</td>
</tr>
<tr>
<td>25</td>
<td>f</td>
<td>Crohn's</td>
</tr>
<tr>
<td>32</td>
<td>m</td>
<td>Post-infectious (prolonged gastroenteritis)</td>
</tr>
<tr>
<td>39</td>
<td>f</td>
<td>NSAID-responsive myopathy, thyroiditis, premature graying of hair; +VGCC ab</td>
</tr>
<tr>
<td>18</td>
<td>f</td>
<td>SFN arose after EBV infection; also h/o lupus panniculitis</td>
</tr>
<tr>
<td>31</td>
<td>m</td>
<td>Post-infectious dysautonomia (one week after fevers/chills/sweats/arthralgias)</td>
</tr>
</tbody>
</table>
Autoimmunity in SFN

25 of 86 SFN classified as possible or probable autoimmune (29.0%)
Autoimmune conditions associated with SFNs

- Sjogren syndrome
- Antiphospholipid syndrome
- Systemic lupus erythematosus
- Mixed connective tissue disease
- Rheumatoid arthritis
- Celiac disease?
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sjogrens</td>
<td>6</td>
</tr>
<tr>
<td>Mixed CTD</td>
<td>5</td>
</tr>
<tr>
<td>Behcet's</td>
<td>2</td>
</tr>
<tr>
<td>Post-infectious</td>
<td>4</td>
</tr>
<tr>
<td>Still's disease</td>
<td>1</td>
</tr>
<tr>
<td>Sarcoid</td>
<td>1</td>
</tr>
<tr>
<td>Chrohn's</td>
<td>1</td>
</tr>
<tr>
<td>Lupus</td>
<td>2</td>
</tr>
<tr>
<td>Other or unspecified</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25 (of 88)</strong></td>
</tr>
</tbody>
</table>
Clinical evaluation – “the workup”

• Check orthostatic vital signs
• For recurrent syncope or tachycardia: cardiac screening including ECG, echocardiogram, prolonged rhythm monitoring
• For orthostatic intolerance: check morning cortisol
• For small fiber neuropathies: screen for autoimmune diseases, alcohol use, etc.

Ongoing discovery of auto-antibodies related to dysautonomia

**Autoimmunoreactive IgGs against cardiac lipid raft-associated proteins in patients with postural orthostatic tachycardia syndrome.**

Wang XL, Ling TY, Charlesworth MC, Figueroa JJ, Low P, Shen WK, Lee HC.


**Autoimmune basis for postural tachycardia syndrome.**


**Antiadrenergic autoimmunity in postural tachycardia syndrome.**


**Angiotensin II Type 1 Receptor Autoantibodies in Postural Tachycardia Syndrome.**


**Autoimmune postural orthostatic tachycardia syndrome.**

Summary

- Disorders of the autonomic nervous system(s) can have many presenting features that cross organ systems and span multiple medical specialties.
- Autonomic disorders are common.
- Autonomic disorders can be assessed and “localized” based on clinical information.
Where can I go to learn more?

- American Autonomic Society
- Dysautonomia International
- The Dysautonomia Project - www.dysautonomiaproject.org
- *Principles of Autonomic Medicine v 2.0*. David S. Goldstein, MD, PhD

https://neuroscience.nih.gov/ninds/Faculty/Profile/david-goldstein.aspx → “Selected Publications” → “Download Publications”
Where can I go to learn more?

The Dysautonomia Project

Understanding Autonomic Nervous System Disorders for Physicians and Patients

Kelly Freeman, MSM
David S. Goldstein, MD, PhD
Charles R. Thompson, MD

Foreword by David Robertson, MD
Questions?
Thank you!