Contemporary Concepts in Dysautonomia Following a Brain Injury

Nathan D. Keiser DC, DACNB
Board Certified Chiropractic Neurologist
Assistant Professor of Clinical Neurology, Carrick Institute
Email: info@drkeiser.com

Head Trauma and Dysautonomia

- Estimated 11.4% of POTS patients report onset within 3 months of concussion.
- Up to 70% of adolescents with PCS have postural tachycardia.

[Miranda et al 2018]

Attendee Goals

- Identify ANS disturbance in a range of TBI patients.
- Quantify ANS disturbance
- Localize neural networks associated with dysautonomia
- Integrate treatment strategies that serve the dysautonomic patient after brain injury

[https://dysautonomiainternational.org/page.php?lid=122]

Functional goals of ANS

- Self-modulated internal environment
- Energy conversion (digestive) system
- Resource distribution system (waste, nutrients, O2, hormones, etc)
- Portability
  - orthostasis
  - exertion
  - Reproduction

Sisacce Bili wins the beam during practice for the senior women's competition at the 2019 U.S. Gymnastics Championships Friday, Aug. 9, 2019, in Kansas City, Mo. [AP Photo/Charlie Riedel]
When the brain is injured we see common autonomic patterns:

- ↑ Heart Rate
- ↑ Blood Pressure
- ↑ Perspiration
- ↑ Pupil Dilation
- ↓ Cranial, GI, Sacral Secretion
- ↓ Central & Peripheral Blood Flow
- ↓ GI Peristalsis
- ↓ Bladder evacuation
- ↓ Sexual Function

Postural Orthostatic Tachycardia Syndrome

**Variants through history**
- DaCosta’s Syndrome
- Soldier’s Heart
- Mitral Valve Prolapse Syndrome
- Neurocirculatory Asthenia
- Chronic Orthostatic Intolerance
- Orthostatic Tachycardia
- Postural Tachycardia Syndrome


**POTS - Upon Standing:**

- Rise in HR more than 30 BPM
- HR maintained at 120 BPM+

*Independent of Blood Pressure*

Can you remember your worst hangover?

**Symptoms**
- Syncope
- Inability to concentrate
- Orthostatic Intolerance
- Migraines
- Frequent Urination
- Weakness
- Photophobia
- Vertigo
- Dizziness
- Bradycardia
- Exercise intolerance
- Anxiety
- High Blood Pressure
- Appetite Disturbance
- Tachycardia
- Mood Swings
- Cardiovascular disease
- Gastrointestinal Problems
- Sensory Hypersensitivity
- Visual Disturbances
- Earache
- Difficulty with recall
Symptoms 1 month after TBI reported the most common symptoms as:

1. fatigue
2. headache
3. dizziness
4. memory trouble
5. trouble sleeping
6. trouble concentrating
7. irritability
8. blurred vision
9. anxiety
10. increased light, and sound sensitivity

(Dikmen et al., 2010)

3 main conditions that we think about when looking at dysautonomia specific to a brain injury:

1. Monosynaptic pathway involvement
2. Polysynaptic pathway
3. Energy expenditure due to inefficiency

(Beck, 2008)

How is this evaluated clinically in a specialty setting?

**Autonomic Testing:**
- HRV testing
- Head up Tilt testing
- Valsalva Test
- HR response to standing

Tilt Testing


HRV Deep Breathing


Valsalva Test

Phase 1: The act of blowing. The pressure within the chest and abdomen increases and increases intrathoracic pressure. This activates the baroreceptor reflex, which slows heart rate. The increased intrathoracic pressure also reduces the amount of blood that comes into the right atrium (decreased venous return or preload).

Phase 2: Decrease of venous return, lower stroke volume, decrease of central venous pressure and decrease of MAP. Decrease of the vagal activity increasing heart rate.

Phase 3: Increase in sympathetic activity, constriction of the arteries (TPR) lightening of the blood pressure at the end of phase 2 (2B).

Phase 4: Relaxation – the end of the maneuver. Intrathoracic pressure decreases, intrathoracic arteries widen, therefore a brief drop in blood pressure. At the same time, the venous blood fills the heart.

Phase 5: Blood pressure rises again from increased TPR (blood pressure overshoot).

This activates the baroreflexes, which results in a drop in heart rate (bradycardia). Eventually, both the blood pressure and heart rate normalize.
“Body Schema”

- Integrated neural representation of the body (the ‘body schema’) and of the space around the body (‘peripersonal space’)
- This DYNAMIC system is MULTIMODAL involving:
  - Visual System
  - Somatosensory System
  - Vestibular System
- Body part-centered reference frames
- Demonstrates significant plasticity

(Holmes & Spence 2004)

Errors in Schema integration cause problems with knowing
1. Where your body parts are in space
2. Where space is in reference to you
3. How to process complex information

Humans are Complex

21 y/o female with head and neck pain, visual disturbance, brain fog, and POTS following head trauma

Clinical Features:

Salient Exam findings:

“The very organ felt to define our humanity, the brain, seems to have been placed in a somewhat precarious position in regards to both vascular perfusion and oxygenation.”

-B. Grubb
16 y/o female with head pain, POTS following head trauma

- Elevated HR with rise of 34 bpm upon standing
- Headache 6 week duration protracted 6/10 VAS.
- Worse with physical, mental and orthostatic stressors.

Salient Exam findings:
- Dysesthesia in left hemi-distribution to light touch, pinprick and vibration.
- Distribution was patchy and changed with orthostasis.
- "Belladonna" pupils
- Sloeens in RAd in the left upper and lower extremities.
- Pronounced acrocyanosis and was cold to palpation in lower 2/3 of both legs.
"The sympathetic neural activity is primarily involved in the regulation of muscular blood vessels that are influenced by the distinctly functional demand of the distinct vascular segment."

(Huang and Tsai, 2009)

Contemporary Concepts in Dysautonomia Following a Brain Injury

Nathan D. Keiser DC, DACNB
Board Certified Chiropractic Neurologist
Assistant Professor of Clinical Neurology, Carrick Institute
email: info@dkeiser.com