

Hot, Stiff, and Twitchy, or Cool, Floppy, and Sleepy: It is not a seizure, but it is not normal!

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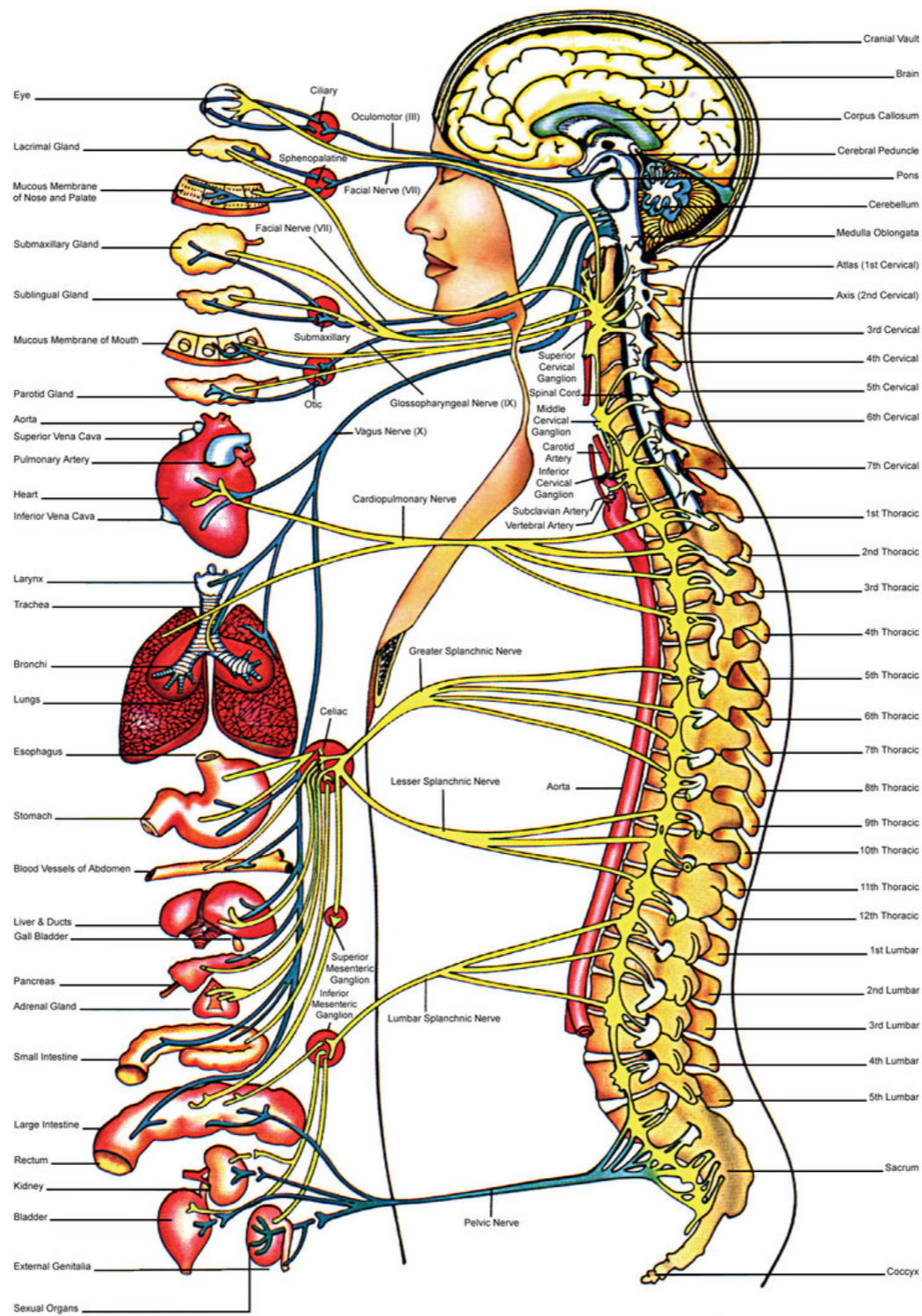
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Learning Objectives

- Identify signs and symptoms of dysautonomia in the medically complex child
- Be aware of the treatment options of dysautonomia in the medically complex child

Dysautonomia

- Autonomic Nervous System
- Responsible for the automatic functions
 - Heart rate, respiratory rate, body temperature, gut motility, bowel and bladder control, sweating, fight or flight response, arousal, sleep/wake cycles, and sexual arousal



AUTONOMIC NERVOUS SYSTEM

Sympathetic -- Yellow Parasympathetic -- Green

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Dysautonomia

- Key components of the autonomic nervous system
- Intrinsic Enteric Nervous System
 - There are more neurons in the gut than in the spinal cord
- Sympathetic-Fast acting, excitatory
 - Cell bodies are far from target organs
- Parasympathetic-Slow acting, predominately inhibitory
 - Cell bodies are near target organs

Dysautonomia

- Hypothalamus
 - Control central for autonomic control
 - Hunger, thirst, circadian rhythm, temperature, and all others
- Midbrain
- Raphe nuclei (Serotonin)
- Substantia nigra (Dopamine)
- Sympathetic Trunk

Types of dysautonomias

- There are two major categories of dysautonomia
 - Hot, wet, agitated, irritable and stiff
 - Cold, dry, sleepy and floppy
- Patients often have one only one flavor of dysautonomia, but this is not an absolute

Hot Dysautonomia

- **Evaluation**

- HISTORY

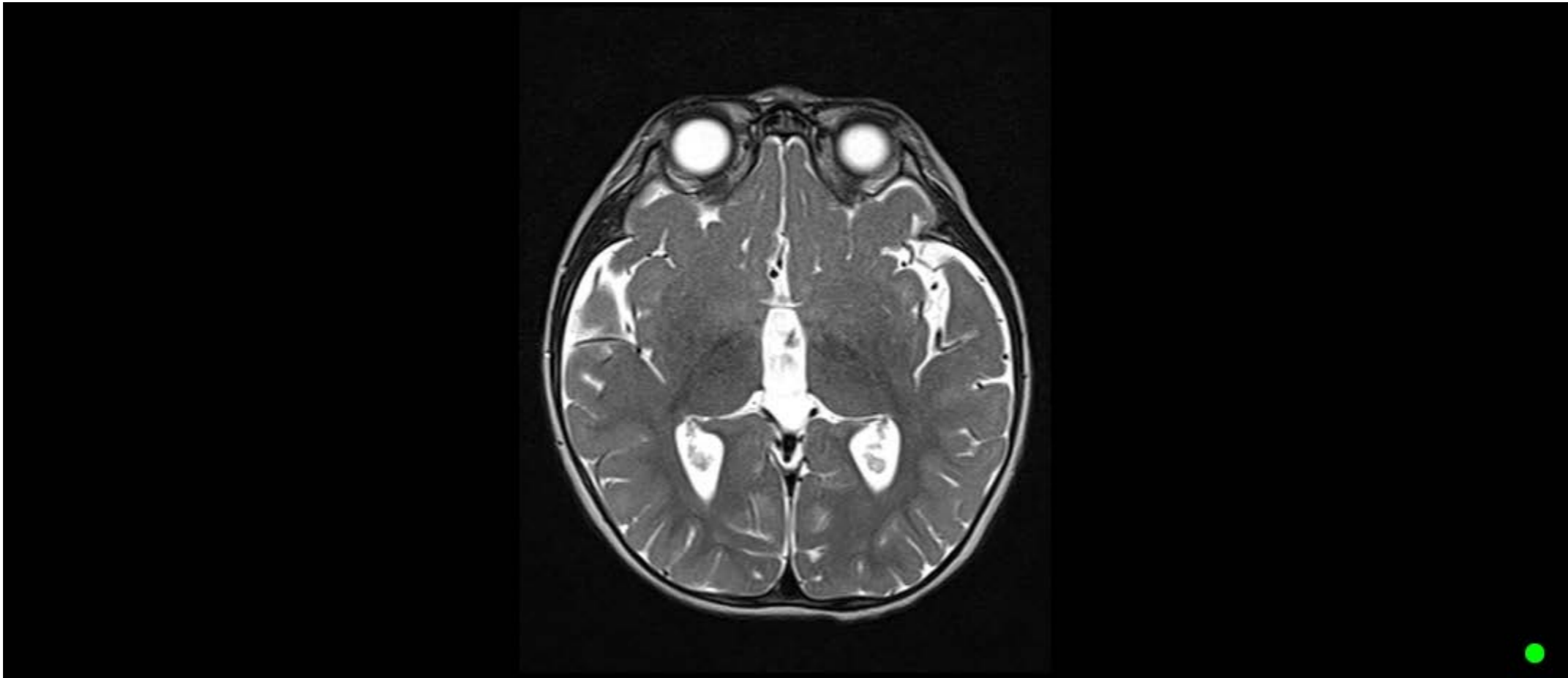
- Characterization of the events, especially duration, timing periodicity helps to delineate between this and all other conditions

- EEG

- If unsure by history of the events. Must capture event on EEG to be sure as many of these patients have seizures as well.

- MRI or CT- Wide third ventricle (lack of hypothalamic volume)

MRI Finding



Cold Dysautonomia

- Key symptoms
- Profound sedation, hypothermia, pallor, cool extremities, hypotension, urinary retention, constipation and **BRADYCARDIA**
- Often mistaken for sepsis, but bradycardia is the key.
- These patient are often closer to the terminal stage of their disease process if degenerative disease is the cause, or have more severe brain injury if that is the cause.
- May be TPN Dependent due to gut shutdown.

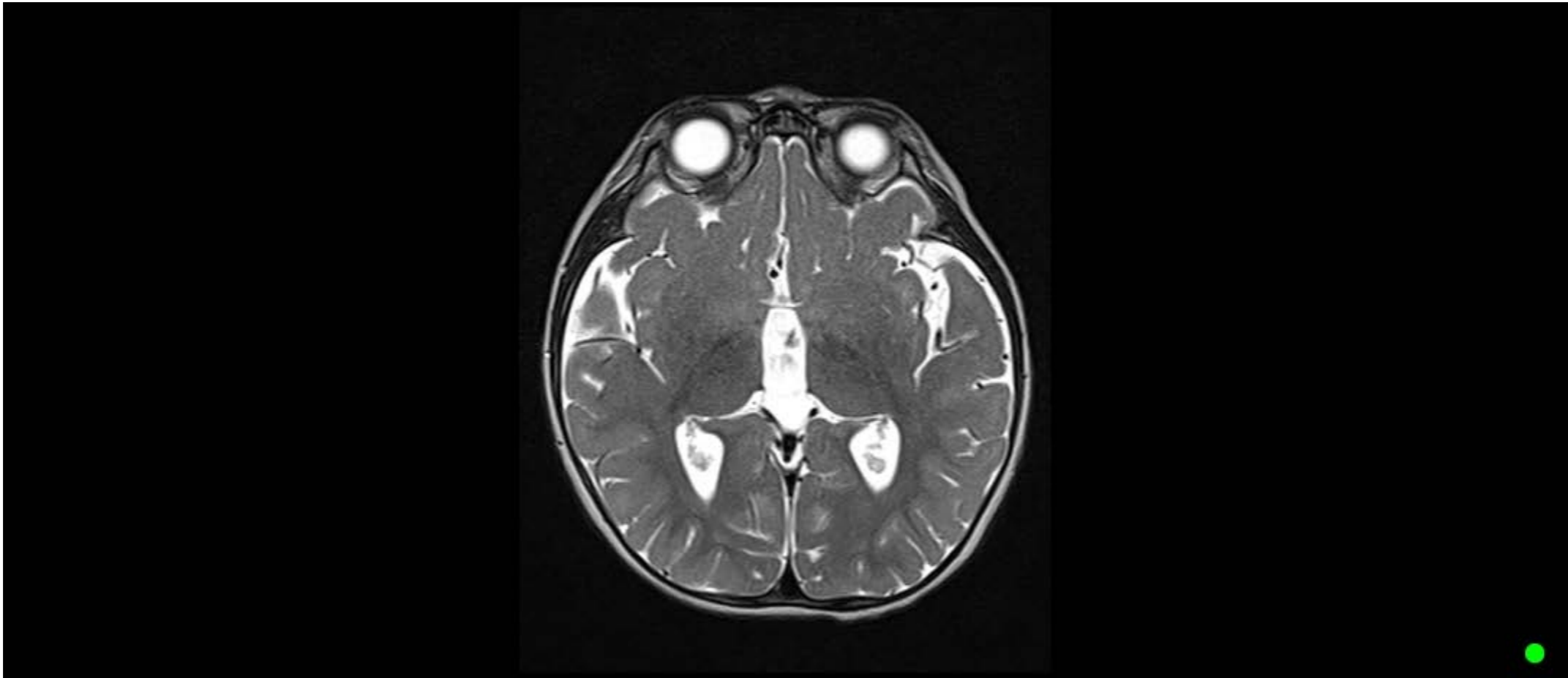
Cold Dysautonomia

- Evaluation
- HISTORY
 - If patients are chronically in this state, the answer is clear.
- EEG
 - If patients have these events episodically, characterize the events (duration, symptoms, body temperature, HR). There is nothing about these types of events that is consistent with epileptic seizures.
- MRI or CT
 - Same as hot dysautonomia -Wide third ventricle (lack of hypothalamic volume)
 - Also look for abnormalities in the midbrain

Cold Dysautonomia

- **Cerebrospinal Fluid Neurotransmitter analysis and treatment**
- It is absolutely critical to evaluate for this in these patients.
- If CSF homovanillic acid (HVA) is low, these patients can improve with dopaminergic medications
- If CSF 5-hydroxyindolacetic acid (5-HIAA) is low, these patient can improve with serotonergic medications
- If CSF 5-methyltetrahydrofolate (5-MTHF) is low, these patients can improve with folinic acid, (leucovorin) 2-5 mg/kg/day.

MRI Finding



Treatment

- Dopaminergic medications if HVA low
 - Carbidopa/Levodopa (Sinemet)
 - Short acting, needs to be dosed three times a day
 - Side effects are insomnia, diarrhea
- Amantadine
 - Side effects are insomnia and agitation
- Serotonergic medications if 5-HIAA is low
 - Selective serotonin reuptake inhibitors
 - Side effects are insomnia, agitation

Treatment

- Fludrocortisone
 - Mineralocorticoid
- Stimulants
 - Methylphenidate (Concerta), also consider Daytrana patch
 - Side effects are insomnia, increased HR and BP
- Midodrine
 - Alpha 1 agonist (black box warning for recumbent hypertension)
 - Short-acting, needs to be dosed four times a day
- Atomoxetine
 - Shown to be more effective than midodrine

Dystonia

- Simultaneous contraction agonist and antagonist muscles around joint sufficient to induce a posture.
- Third most common movement disorder.
- Often very painful and can lead to secondary orthopedic complications.
- Additionally, it can lead to severe constipation and reflux.

Dystonia with dysautonomia

- Also known as paroxysmal sympathetic hyperactivity (PSH)
- This disorder is seen in patients with severe brain disease
- These are often called, incorrectly, "thalamic storms."
- In actuality, they are hypothalamic in origin.

Paroxysmal sympathetic hyperactivity

- Acute onset of severe, often generalized dystonic posturing accompanied by hyperpyrexia, tachycardia, hypertension, tachypnea, and diaphoresis.
- Obviously, this is often mistaken for seizure.
- These episodes last multiple minutes to multiple hours. They are absolutely exhausting and quite painful, and do not respond to anticonvulsants or benzodiazepines.
- EEG is NORMAL during these events.

Paroxysmal sympathetic hyperactivity

- Abortive therapy is ineffective.
- Prophylaxis is the key treating this problem.
- There is little data about what is effective.

Treatment

- Non-pharmacologic measures
 - Control room temperature
 - Low stimulation environment
 - Emphasis on regular sleep-wake cycles

Treatment

- Alpha-2 Agonists (Dexmedetomidine, Clonidine)
 - Targets blood pressure, heart rate, agitation
- Beta Blockers
 - Propanolol is first line

Treatment

- Baclofen
 - GABA-B agonist
 - Provides control of spasms and tone; improves mobility
- Gabapentin
 - GABA analog that works at voltage-dependent calcium channel
 - Reduces number of paroxysms and use of other medications

THANK YOU FOR YOUR TIME AND ATTENTION