Stress and the Autonomic Nervous System

Autism ONE
Lombard, Illinois
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Anju Usman, MD
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Stress and the Autonomic Nervous System

Biomedical Stressors
- Genetic predispositions
- Mother’s Burden
- Toxic Metals
- Environmental Pollutants
- Electromagnetic Fields
- Sensory Input
- Stress/Internal Conflicts
- Dietary Factors
- Allergens
- Microbial/Biofilm
- Immune/Inflammatory Burden

Sometimes the most important thing in a whole day is the rest we take between two deep breaths.

Etty Hillesum

Negative Ways of Handling Stress
- Watching television
- Skipping exercise
- Junk food, Fast food
- SUGAR
- CAFFEINE
- Pharmaceuticals
- Alcohol
- Cell Phones, Emails, Texting, Internet
- Anger, Yelling, Blaming Others...
- Loss of self confidence and self esteem

Stressed Out Lives!
- Biomedical
- Physical
- Mental
- Emotional
- Social

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Disclaimer
- Information is for educational purposes only
- Not to be taken as specific medical advice
- All medical decisions regarding your child’s health issues should be discussed with your health care provider
- Clinical trials have not been done on treatment approaches discussed
Stress Can Age You

- University of California, San Francisco, looked at white blood cells in mothers whose children suffered from chronic disorders like autism.
- They found clear signs of accelerated aging in mothers who had cared the longest for children with disabilities.
- The youngest cells boast the longest telomeres.
- But telomeres in the more stressed-out moms were significantly shorter.
- Reflects an accelerated aging pattern from 7-15 yrs.

Stressed Out Babies

In Utero - work, marriage, vaccines, diet, ultrasound, meds...
Delivery
Premies
Infancy
- Metabolic
  - Toxins – metals, chemicals
  - Allergens
  - Dietary
  - Infections
  - EMFs
  - Pharmaceutical Agents
- Psychosocial
  - Sensory overload
  - Constant demands
  - Separation

“Stress in infancy can affect genetics for generations to come”

How do children manifest stress?
- Colic
- Sleep disruption
- Sensory issues - texture, sound, lights
- Flight or fight response (running or aggression)
- Tantrums/Meltdowns
- Isolation/disengaged
- Need for sameness

How do children manifest stress?

What are the main metabolic manifestations of chronic stress?
- Nervous System Maladaption
- Endocrine/Hormone Imbalance
- Immune/Inflammatory Dysregulation
- Gastrointestinal Disorders
- Mitochondrial Dysfunction
- Oxidative Stress

Nervous System

- Autonomic Nervous System
  - Sympathetic
  - Parasympathetic
- Neuroendocrine System
  - Hypothalamus/Pituitary Axis
- Limbic System
  - Emotional Nervous System

The Emotional Nervous System

The Limbic System

- Pituitary
- Hypothalamus
- Amygdala
- Hippocampus
- Cingulate Gyrus
- Basal Ganglia
- Ventral Tegmental
- Prefrontal Cortex

Emotions
Memories
Aggression
OCD
Pleasure/Pain
Focus/Attention

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Cortisol Levels During Human Aging Predict Hippocampal Atrophy and Memory Deficits

- Elevated glucocorticoid levels produce hippocampal dysfunction and correlate with individual deficits in spatial learning in aged rats.
- Humans with significant prolonged cortisol elevations showed reduced hippocampal volume and deficits in hippocampus-dependent memory.
- The degree of hippocampal atrophy correlated strongly with both the degree of cortisol elevation over time and current basal cortisol levels.
- Therefore, basal cortisol elevation may cause hippocampal damage and impair hippocampus-dependent learning and memory in humans.

Dr. Martha Welch 2009
- Hypotheses
  - Inflammation is encoded by the brain
  - Inflammation (stress) causes the individual to maladapt
- Assumptions
  - The brain and gut form a single physiologic circuit
  - The gut-brain axis is the crossroads of conditioning via interaction with mother
  - The gut is critical to conditioning reactions to stress in the early post-natal period
- Treatment
  - Peptides like Secretin and Oxytocin can help a dysregulated gut-brain system

Combined Administration of Secretin and Oxytocin Inhibits Chronic Colitis and Associated Activation of Forebrain Neurons

- Journal of Neurogastroenterology and Motility 2010
  - Secretin expression in the colon is lower than in the intestines
  - S/OT decreased TNF alpha and IFN gamma in the colon
  - S/OT combo reduced inflammation
  - S/OT decreased ulcers
  - S/OT decreased IL-6 in amygdala
  - S/OT may act in synchrony

Secretin
- Gut motility
- Alkalization
- Co-localize with serotonin
- Improves bile flow
- Increases blood flow to GI
- Brain affects NE, Dopamine, Angiotsensin II, AT(1)R
- Released by Hypothalamus

Oxytocin
- Gut motility
- Inhibits gastric acid
- Vasodilation
- Co-localize with CCK
- Brain antagonists to CRH
- Released by Amygdala

Influence of pediatric vaccines on amygdala growth and opioid ligand binding in rhesus macaque infants

- Vaccinated animals showed an increase in total brain volume.
- The amygdala, a specific part of the brain associated with emotional responses did not show abnormalities until after the 12-month vaccines had been given.
- In addition, after the 12-month vaccines only, the functional brain scans showed significant differences between vaccinated and unvaccinated groups.
- Vaccine administration was associated with an increase in opioid binding activity in the amygdala compared with a decrease in the unvaccinated group.

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Autism, amnesia, hippocampus and learning
DeLong GR,
Neurosci Biobehav Rev. 1992

"Autism is postulated to be the developmental syndrome of hippocampal dysfunction. The hippocampus is postulated to be necessary for normal development in the child of language syntax, semantics, and pragmatics; the capacity for creativity and generativity in language and behavior, and combinatorial possibilities in general; for the integration of motivational states with experience and learning; and for the construction of a complex, useful and flexible structure of meaning."

HPA Axis and the Nervous System:
The Neuroendocrine System

- Controls reactions to stress and regulates many processes, including digestion, immunity, mood and emotions, sexuality, and energy storage and use.
  - Hypothalamus - homeostasis of the body
  - Pituitary - master gland of the endocrine system
  - Adrenal Gland - interfaces with Hypothalamus
- Neurobiology of mood disorders and functional illnesses, including anxiety, insomnia, PTSD, ADHD, chronic fatigue syndrome, fibromyalgia and IBS.
- Both hormones and neurotransmitters are chemical messengers. They just travel thru different pathways.

50% of 30 kids with ADD showed an abnormal HPA response.
As measured by an abnormal dexamethasone suppression test (DST) and abnormal diurnal rhythm.

Normal Diurnal Cortisol Pattern

Abnormal Diurnal Cortisol Pattern

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Stress and the Autonomic Nervous System

Adrenal Hormones

Adrenal Cortex
- Steroid Hormones
  - Cortisol (glucocorticoid)
  - Aldosterone (mineralocorticoid)
  - Progesterone
  - DHEA
  - Testosterone
  - Estrogen

Adrenal Medulla
- Catecholamines
  - Epinephrine
  - Norepinephrine

Adrenal Pathways

Smith Lemli Opitz Syndrome and Low Cholesterol

- Benefits of cholesterol feeding in SLOS
  - Kelty RT. Inborn errors of cholesterol biosynthesis. Adv Pediatric 2000;47

  - Beginning to walk
  - Starting to run
  - Growth improvement
  - Less infections
  - Less UV light sensitivity
  - Increased alertness
  - Head banging stops
  - Decreased tactile defensiveness
  - Increased sociability
  - Behavior improves
  - Talking started in adults

Adrenal Response to Stress

Adaptation
- 3 stages
  - Alarm (increased cortisol, normal DHEA, increased epinephrine, norepinephrine)
  - Resistance (pregnenolone steals cholesterol to make cortisol, but at the expense of sex hormones, increased cortisol, low DHEA)
  - Exhaustion (low cortisol, low DHEA)

Impact of Adrenal Stress Syndrome

Blood Sugar Imbalances
- High cortisol, insulin receptor insensitivity, excess insulin production. Insulin resistance and hyperglycemia.
- Low cortisol affects liver’s ability for gluconeogenesis and glycogenolysis, causing hypoglycemia.

Impact of Adrenal Stress Syndrome

Sleep
- Adrenal hypofunction, low cortisol, loss of ability to maintain blood sugar levels at night, causes stress response.
- The stress response causes the medulla to secrete epinephrine and norepinephrine to try to mobilize glucose to compensate for a lack of cortisol.
- Epinephrine and Norepinephrine activate the sympathetic nervous system and cause night time awakening.

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Impact of Adrenal Stress Syndrome

**Thyroid Defects**

- High cortisol has a suppressive effect on S’deiodinase which converts T4 (inactive) to T3(active).
- T4 is converted to T3, reverse T3, T3 sulfate and T3 acetic acid.
- If T4 is normal and T3 is low, think of adrenal stress.

Geuchot, Physiological and pathological variations in salvia cortisol. 1982
LoPresti, Thyroid response in critical illness. 1997

**Gastrointestinal Function**

- High cortisol suppresses secretory Immunoglobulin A (sig A)
- High cortisol contributes to dysbiosis
- High cortisol causes thinning of the GI lining
- Food allergies/sensitivities activate the GALT and place the body in an alarm pattern
- High cortisol decreases gastric and colonic motility causing GERD and constipation

Cunningham-Rundles. 1978, 1979
Guhad. Salivary IgA as a marker of social stress in rats. 1996.
Soderholm. Stress and the gastrointestinal tract. 2001

Gut Brain Axis

- A bidirectional communication system between the brain and gastrointestinal systems.
- Communication occurs along immunologic, neural, and biochemical pathways.
- Gut microbiota can effect both brain development and behavior.
- Stress also can alter the composition of Gut microbiota.

**Maternally separated rats have increased cortisol and increased BDNF.**
**Bifidobacterium replacement improves hippocampal BDNF but not in maternally separated rats.**

Maternally separated rats have increased cortisol and increased BDNF. Bifidobacterium replacement improves hippocampal BDNF but not in maternally separated rats.

**Stress and the Gut**

- When young rats are separated from their mothers, the layer of cells that line the gut becomes weakened and more permeable.
- Dr. Mayer Emren, professor of physiology and psychiatry at UCLA reports that 70 percent of his patients with chronic GI disorders had early childhood traumas.
- He has also found that the majority of patients with anxiety and depression have some alteration in their GI functions.
Stress and Friendly Bacteria

Prenatal stress alters the bacterial colonization of the gut in infant monkeys. Stress reduced the overall numbers of bifidobacteria and lactobacilli. (Bailey, 2010)

Exposure to stress in mice reduces the number and diversity of commensal microbial populations while leading to increased colonization by Citrobacter rodentium. (Bailey, 2010)

Probiotics as Psychotropics

Emerging literature is showing the beneficial effect of oral probiotics on mood and anxiety symptoms.

In a double blind, placebo-controlled randomized parallel group study, daily use of probiotics reduced psychological distress. (Messasoudi, 2010)

A number of studies have shown the anti-anxiety effects of probiotic use in patients with medical conditions. (Silk, 2009; Sullivan 2009; Patel, 2008; O’Brien, 2004)

Impact of Adrenal Stress Syndrome

Immune

- Elevated cortisol
  - Low secretory Ig A, which affects mucosal barriers like GALT (gut associated lymphoid tissue)
  - BALT (bronchial associated lymphoid tissue)
  - BBB (blood brain barrier)
  - Skin
- Low wbc
- Atrophy of thymus
- Decreased IL 2 production
- Shortened telomeres in wbc

Daynes, R. 1990

Adrenals and Immune Cont’d

"Neurotensin is increased in serum of young children with autistic disorder”
Theoharis C. Theoharides

- Neurotensin could act with CRH (corticotropin releasing hormone) to stimulate mast cells and lead to neurogenic inflammation
- NT stimulates lymphocytes, activates T cells, and enhances interleukin 1 from macrophages
- Select flavinoids inhibit release of proinflammatory mediators from mast cells

Mitochondria and Stress

"Dynamic regulation of mitochondrial functions by glucocorticoids” Proc Natl Acad Sci USA. 2009 Feb 2; 106; 1 and Manji, H.

- In brain cells of rats treated with corticosterone, GR latched onto Bcl-2, a protein that affects how substances get in and out of mitochondria. Brief increases of corticosterone enhance mitochondrial functions.
- High doses or long-term treatment with corticosterone led to decreased levels of GR and Bcl-2 in mitochondria. Similar results occur in rats exposed to chronic stress.
- Cortisol boosts mitochondrial functions to provide cells with more energy for coping with and adapting to acute challenges.
- However, chronically elevated levels of cortisol may reduce mitochondria cell functioning. The decrease in proper cell function may be at the root of certain chronic physical and mental illnesses.

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**Stress -Induced Oxidative Changes in Brain**

CNS and Neurological Disorders Oct. 2006. Madrigal, M.

- Numerous systems and organs are affected by stress.
- Stress causes the atrophy of hippocampal dendrites or even the reduction of the hippocampal size observed in brains from subjects exposed to severe or chronic stress.
- Excess glucocorticoids can result in neurotoxicity, modifications in energy metabolism, and an increase in excitatory amino acids such as glutamate.
- Leads to the activation of TNFα convertase (TACE) and TNFα release in brain of rats subjected to restraint stress. TNFα initiates the translocation of the transcription factor NFκB to neuronal nuclei.
- NFκB activation results in the induction of iNOS and COX2, two enzymes responsible for a great portion of the neurological damage produced in models of stress.

**Bacopa helps oxidative stress, anxiety, and stimulating in autistic rats**


Abstract

Bacopa monnieri (L.) are known for their antioxidant and neuroprotective effects. In this study, we investigated the neuroprotective effects of Bacopa monnieri in an animal model of oxidative stress in the brain. The results showed that Bacopa monnieri significantly reduced the levels of lipid peroxidation and nitric oxide in the brain. These findings suggest that Bacopa monnieri may have potential therapeutic applications in the treatment of oxidative stress-induced disorders.

**Zinc Deficiency and Stress**

- There is a growing body of literature supporting the association between zinc and ADHD, anorexic behaviors, depression, and anxiety.
- Zinc plays a role in serotonin and glutamate activity as well as oxidative stress.
- Zinc deficient animals exhibit anxiety like behaviors.
- Rats fed a zinc deficient diet were shown to have higher levels of corticosterone following exposure to stress.

**Chronic Stress**

HPA Axis

- Adrenal Stress
- Neurotransmitter Imbalances
- Abnormal Cortisol
- Hormone Imbalances
- Decreased Immunity
- Gastrointestinal Disorders
- Blood Sugar Dysregulation

**Dysautonomia**

Dysfunction of the Autonomic Nervous System (ANS)

- Nervous System
- Immune System
- Gastrointestinal System
- Cardiovascular System
- Endocrine/Hormone System

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**Autonomic Nervous System**

*Fight and Flight = Sympathetic Nervous System*

*Rest and Digest = Parasympathetic Nervous System*

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Stress and the Autonomic Nervous System

Symptoms of Dysautonomia

- Excessive fatigue, sleep disruption
- Excessive heat or cold
- Loss of sweating or excessive sweating
- Excessive urination and thirst, salt cravings
- Lightheadedness, dizziness, orthostatic hypotension, syncope
- Rapid or slow heart rate
- Noise and Light Sensitivity
- Tremulousness, Dysequilibrium
- Feelings of anxiety or panic
- Headaches, nerve pain, numbness
- Facial flushing
- Constipation, Diarrhea, Nausea, Reflux, Dysmotility
- Seizures

Possible Signs and Symptoms of Dysautonomia in ASD

- Poor self regulation/tantrums
- Light and Sound sensitivities
- Irritable when misses meals
- Difficult transitioning to new environment
  - Light, sound, temperature changes
- Need for deep pressure to help regulate
- Head banging
- Food refusal
- Licking behavior (salt seeking)

Reduced Cardiac Parasympathetic Activity in Children with Autism

Xue Ming
Brain and Development October 2005

- Many of the clinical symptoms of autism suggest autonomic dysfunction.
- The aim of this study (n=28), (control=117) was to measure baseline cardiovascular autonomic function in children with autism.
- The results suggest that there is low baseline cardiac parasympathetic activity with evidence of elevated sympathetic tone in children with autism whether or not they have symptoms or signs of autonomic abnormalities.

Heart Rate Variability

Changing Heart Rhythms

- Frustration
- Appreciation

Heart Rate Variability

Multiscale Model for the Assessment of Autonomic Dysfunction in Human Endotoxemia

Foteinou PT
Physiol Genomics. 2010 Jun

Severe injury and infection are associated with autonomic dysfunction. The realization that a dysregulation in autonomic function may predispose a host to excessive inflammatory processes has renewed interest in understanding the role of central nervous system (CNS) in modulating systemic inflammatory processes. Assessment of heart rate variability (HRV) has been used to evaluate systemic abnormalities and as a predictor of the severity of illness.

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Causes of Dysautonomia

- Autoimmune disorders esp. Type I diabetes
- Brain injury
- Neurodegenerative diseases
- Exposure to toxic chemicals
- Infections (viral)
- Genetic factors
- Hereditary connective tissue diseases
- Pregnancy
- Physical Trauma
- Unknown

Autonomic Nervous System (ANS)

- Act in opposition
- Affects
  - heart rate
  - digestion
  - respiration rate
  - salivation
  - perspiration
  - diameter of the pupils
  - urination
  - sexual arousal
- Neurotransmitters
  - Acetylcholine
  - Norepinephrine and Epinephrine

The Vagus Nerve

- Main nerve of the parasympathetic nervous system
- Inherently communicates with the splenic nerve to suppress TNF alpha production in the spleen and modulate immune function. (Dr. Rosas-Ballina)
- Efferent or Dorsal Motor Vagus Nucleus (DMV)
  - Motor to Pharynx, Larynx, GI, Bladder
- Afferent or Sensory (80%)
  - Back to the brain from the ear, tongue, larynx, GI tract
- Releases ACh (acetylcholine)
  - Nicotinic Receptors
  - Muscarinic Receptors

Neurotoxic Brainstem Impairment as Proposed Threshold Event in Autistic Regression


- Oxidative Stress, inflammation and immune abnormalities seen in ASD are related to a toxic injury to the primitive brainstem.
- Impairment of the dorsal vagal complex (DVC) could account for the cardinal features of autism.
- Regression after age 1 could be triggered by toxic effects on small areas of the brainstem that lack blood-brain-barrier (BBB).

Vagus Nerve Cools Gut Inflammation

Mice exposed to sodium dextran sulfate to stimulate inflammatory bowel disease.
Mice with intact vagus nerve exhibit less inflammation in the gut.
Mice with vagus nerve cut produced heightened inflammation in the gut.
The vagus nerve by releasing Acetylcholine stimulates T regulatory cells that lower inflammation.

Slow – Transit Constipation

Intem. Symposium of Gastrointestinal Motility, Copenhagen, Denmark, 1996 Altomare, et al...

- Autonomic neuropathy thought to play a role in the pathogenesis of slow transit constipation.
- Common issues - eg. reflux, gallbladder dystmotility, decreased gastric emptying, delayed orocecal transit time, abnormal recto-anal inhibitory reflex, decreased rectal sensitivity.
- Autonomic neuropathy in 14/18 pts. (SST=sweat spot test)
- Slow transit constipation is associated with impaired function of other gastrointestinal organs.
- Severe constipation may be the main complaint of a systemic disease involving several organs and possibly the autonomic nervous system.
Basic Biomedical Strategy
- History and Physical Examination
- Laboratory Testing
- Clean Up
  - Environment
  - Diet
  - Gut
  - Stressors
- Start Foundational Nutrients
- Address HPA Axis and Dysautonomia
- Treat Underlying Immune Issues and Inflammation
- Support Detoxification Pathways, Methylation, Sulfation, Glutathione
- Address Mitochondrial Dysfunction
- Heavy Metal/Chemical Detoxification

History
- Adrenal Stress
- Glycemic Control
- Autonomic Function
  - Temperature Regulation
  - Sweating
  - GI Motility
  - Sensory Issues
  - Sleep patterns

Signs and Symptoms of Adrenal Stress

<table>
<thead>
<tr>
<th>Adrenal Hypofunction</th>
<th>Adrenal Hyperfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannot stay asleep</td>
<td>Cannot fall asleep</td>
</tr>
<tr>
<td>Craves salt</td>
<td>Perspires easy</td>
</tr>
<tr>
<td>Slow starter</td>
<td>Lots of stress</td>
</tr>
<tr>
<td>Afternoon fatigue</td>
<td>Weight gain</td>
</tr>
<tr>
<td>Dizziness on standing</td>
<td>Craves sweets after meals</td>
</tr>
<tr>
<td>Afternoon headaches</td>
<td>Sleepy after meals</td>
</tr>
<tr>
<td>Low cortisol</td>
<td>Wakes up tired</td>
</tr>
<tr>
<td>Hi epinephrine</td>
<td>Hyperactivity</td>
</tr>
<tr>
<td>High anxiety</td>
<td>High cortisol</td>
</tr>
<tr>
<td>Low glucose (hypoglycemia)</td>
<td>High glucose (hyperglycemia)</td>
</tr>
<tr>
<td>Craves sweets</td>
<td>Insulin resistance</td>
</tr>
<tr>
<td>Irritable if meals missed</td>
<td>High Testosterone (women)</td>
</tr>
<tr>
<td>Better with meals</td>
<td>High Estrogen (men)</td>
</tr>
</tbody>
</table>

Physical Signs Associated with Dysautonomia
- Low or High body temperature
- Lack of sweat or too much sweat
- Dry sand paper skin
- Abnormal pupillary response
- Poor skin turgor
- Low blood pressure (orthostatic hypotension)
- Abnormal beat to beat variability
- Ridges or bite marks on the sides of the tongue
- Hyperlaxity in joints

Rubin LS. Patterns of pupillary dilatation and constriction in psychotic adults and autistic children. 1963

Orthostatic Hypotension
- Normally when a person goes from lying down to standing, the systolic blood pressure should elevate 4-10 mm Hg.
- In hypoadrenia, the systolic blood pressure from lying to standing will either stay the same or drop. This systolic drop is usually between 5 to 10 mm. Hg., but sometimes as much as 30-40 points, known as the Ragland effect, or postural hypotension, and which is reported in over 90% of hypoadrenic persons.
- Blood pressure should always be checked in three positions: sitting, then lying, then standing. From recumbence to standing, the systolic blood pressure should rise 4-10 points.
- If the blood pressure drops, suspect functional hypoadrenia.

Lab Options HPA Axis
- Blood Sugar
- Insulin
- Cortisol
- Aldosterone
- DHEA
- Testosterone
- Estrogen/Progesterone
- ACTH and ACTH stim test
- Cholesterol
- TSH, T3, T4

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Evaluation of Stress Symptoms

- Physical exam findings
- Non-invasive tests
  - Heart rate variability
  - Salivary DHEA and cortisol
  - Cutaneous sweat patches for neural and immune biomarkers
  - Urinary catecholamines
  - Tilt table testing

Special Environmental and Dietary Considerations

- Avoid chemical endocrine disruptors especially pesticides, plasticizers, BPA, phthalates, organophosphates...
- Low glycemic, limit sugar and carbs
- Protein and fiber with meals and snacks
- 3 meals, 3 snacks per day
- Bedtime snack with protein
- Limit hormones and excitotoxins in food
- Exercise

Address HPA Axis

- Adaptogenic Herbs
  - Panax Ginseng
  - Siberian Ginseng (eleutherococcus)
  - Ashwagandha (withania somnifera)
  - Rhodiola
  - Holy Basil (tulsi)
- Other
  - Vitamin B5/Pantothenic Acid
  - Lecithin/Soybean phosphatidyl serine (increases cortisol)
  - Phosphatidyl serine (lowers cortisol)
  - Glandulars (Adrenal Cortical Extract)
  - Hormones (Pregnenolone, Progesterone, DHEA)

Support Blood Sugar Regulation

- Chromium
- Vanadium
- Gymnema sylvestre
- Bitter melon
- Cinnamon
- Alpha Lipoic Acid
- Carnitine
- Omega 3 EFA

Gaffny. Panax ginseng and Eleutherococcus senticosus may exaggerate an already existing biphasic response to stress via inhibition of enzymes which limit the binding of stress hormones to their receptors. 2001

Spasov. A double-blind placebo controlled pilot study of the stimulating and adaptogenic effect of Rhodiola rosea on the stress induced fatigue of students...2000
Address Dysautonomia

- Down-regulate Sympathetic
  - Down regulate excitatory neurotransmitters
    - NE and Epinephrine (adaptogens)
    - Glutamate (mexamine, Mg, Li)
- Up-regulate Parasympathetic
  - Acetylcholine (phosphatidylcholine, serine)
  - Acetylcholinesterase Inhibitors (galantamine)
- Salt
- Beta blockers

Address Neuroendocrine System

- Hippocampus
  - Secretin (nasal, transdermal, IV)
  - Phosphatidyl Serine
  - Lower Cortisol
- Amygdala
  - Oxytocin (nasal, oral)
- Blood-Brain-Barrier
  - Vit A, Vit E, Saccromyces boulardii

Positive Ways of Handling Stress

- Breathing (www.heartmath.org)
- Meditation/Prayer/quiet Time
- Exercise- low impact
- Singing, Chanting
- Healthy Diet and Bedtime Routines
- Improving self esteem/confidence (attitude)
- Sleeping
- Just Relaxing and Slow Down
- EFT (emotional freedom technique)
- Biomedical Interventions

Thank YOU!
And don’t forget to take a deep breath!!
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