Neuroendocrine Biology of Cognition in Depression

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Abstract

Stress or sensory information comes from our environment into our brain from our sight, smell, sound, touch, and taste. The amygdala is responsible decide if any stress or sensory information is dangerous or harmful. The limbic system is the hypothalamus control center to evaluate neurochemicals to perceptions of fear, anger, disgust, sadness, happiness and surprise.

When the brain perceptions trigger the amygdala, the autonomic nervous system initiates survival of necessary organs to fight, flee, freeze, or fawn. The kidneys use renin, angiotensin, erythropoietin, iron, and antidiuretic hormone to maintain fluid and temperature balance in the blood vessels, heart, respiratory system, and lymph system. The pancreas uses glucagon and insulin to regulate glucose as the main source of energy for fight or flight as well as growth and development. The pineal gland uses melatonin and serotonin for regulation of sleep and cognition as well as alertness as awareness in fight or flight. The thyroid and parathyroid regulate all organ systems required for homeostasis of bodily functions at rest and for survival.

Keywords: Homeostasis • Respiratory system • Energy • Blood vessels • Glucagon

Introduction

There are twelve endocrine organs: Adrenal glands, hypothalamus, hypophyseal portal blood vessel system, pituitary glands, kidneys, thymus, lymph system, gonads (ovaries and testes), pancreas, parathyroid, thyroid, and pineal gland [1]. The hypothalamus stimulates Thyroid Releasing Hormone (TRH), Growth Hormone Releasing Hormone (GHRH), Gonadotropin Releasing Hormone (GnRH), and corticotropin Releasing Hormone (CRH) to affect the adrenal glands release of aldosterone, corticosteroid, epinephrine (adrenaline), norepinephrine, Dehydroepiandrosterone (DHEA) on the function of the anterior or posterior pituitary glands which enter into the portal vein of the hypophyseal portal system capillary beds to process vasopressin or Antidiuretic Hormone (ADH), adrenaline or epinephrine, Adrenocorticotropic Hormone (ACTH), somatostatin hormone as well as sex hormones estradiol, progesterone, Follicle Stimulating Hormone (FSH), Luteinizing Hormone (LH), and testosterone [2-4]. Neuroendocrine biology and chemistry affect the neurotransmitters dopamine, serotonin, and norepinephrine. These neurotransmitter pathways are a key assessment component along with the cognitive assessment tools for executive functioning, immediate delayed memory, learning, attention and concentration, and procession psychomotor speed.

Estrogen and testosterone especially have an affinity for serotonin and dopamine which brings about the importance of lifelong learning in a world where we have 40 years-50 years learning and work life [5,6].

Adolescents start working part time and continue to work, learn, and be productive citizens in United States until early retirement at age 62, but full retirement with Medicare insurance at 70. It is vital to the economy not only in the United States, but internationally, to recognize that a healthy neuroendocrine system brings about a health digestion and immunity which promotes long and productive quality of life. No longer can humanity afford to live long but comorbid lives of poor quality that drains the economy and mental health of family [7-9].

Preventative care needs to include yearly cognitive function testing in early education, neuroendocrine education in schools and the workplace, and insurance preventative coverage as wellness care just as a wellness physical yearly exam for all ages.

Importance of the review of neuroendocrine biology, cognition and depression

There is not a gold standard screening tool for cognition deficits in depression. The PHQ-9 screening tool was introduced in 2001. Today, it is a screening tool for depression reimbursed by insurance companies and a self-administered quick and easy to use patient self-assessment.

Literature Review

The PHQ-9 has nine questions that address feelings of failure, lack of energy, restlessness, hopelessness, thoughts of self-harm, lack of pleasure, difficulty concentrating or extremes like sleeping to much or not enough, poor appetite or overeating, speaking slowly or unable to sit still [10-14].

National institute of health offers a cognitive health toolbox based on age starting at 3 years old to 6 years old, 7 years-17 years old and 18 plus. The missing link is the distinction in cognition with the onset of puberty, the neuroendocrine system development, anywhere from 9 to 17 [15-17]. Teenage suicide, caused by adolescent depression, increased populations in crowded schools, and with development of technology requiring brain development of the neuroendocrine system that is only beginning to develop, but not understood by teachers, parent and clinicians in all disciplines of healthcare and educational settings leaves too many teenagers without leadership and mentorship.

Internationally, we have for two decades told preteens and adolescents what is wrong with them, their character, their laziness, and blamed parents for being less than the perfect parent; but if we look at the neuroendocrine system, we may just find that humans were not meant to function in the society we have built. Trillions of dollars in research would suggest that probability would benefit humanity to change society based on biology and chemistry [18].

Discussion

From 3 years old to 17 years old, every human can learn their own genetics, personality, brain chemistry, how they learn best and what they need to try harder at to become who they were built to be and merge that with what they want to become. At onset of adulthood, the generations to come will focus on balancing life and work in a society built for humanity based on neuroendocrine biology to improve cognition, balance moods, and maintain energy with balanced nutrition and sleep. Most of all to include exploring their neighborhoods, cities, states, and countries [19].

Traveling and friendship promotes socialization in real time teaching that social media, news, and marketing promotes an unrealistic view of the world, moments in time but not the ups and downs of a journey like compared to adventure, exploration, and observation of the world; which requires how you respond to fear, anger, anxiety when plans fail during a trip or how accomplishment feels when family and friends communicate to solve a problem in real life like a failed plan on a trip. All these real-life adventures require knowledge of neurology, human fight or flight response system, neuroendocrinology, and tools for dysregulation of fear, anger, anxiety, critical thinking, problem solving, and communication [20,21].

The national institute of health tool box includes all these tools to assess

- Executive functioning by inhibitory control, attention span, and dimensional change card sorting tests.
- Memory tests specifically episodic memory with picture sequence, working memory with list making and sorting ability, and immediate recall memory with auditory verbal learning tests.
- Language skills testing with picture vocabulary and oral reading recognition.
- Brain processing speed.

Conclusion

Pancreatic Neuroendocrine Tumors (PNETs) are becoming increasingly important both clinically and from a research standpoint. Numerous advances, including the discovery of novel diseases, have been made in recent decades through clinical, basic, and translational research. The knowledge of and experience with PNETs are sufficient so that most patients with PNETs today should expect a satisfactory diagnosis and treatment at academic centers with a multidisciplinary team experienced in PNETs. To increase the understanding of PNETs and to develop more diagnostic and treatment modalities, we advocate that patients should be encouraged to seek opinions from academic centers with a multidisciplinary team experienced in PNETs and to be enrolled in clinical studies. We also suggest that in countries or regions where such centers are lacking, interested physicians should form their own multidisciplinary teams. Clinically, the natural history of sporadic PNETs needs to be addressed directly, and comparative efficacy studies need to be performed to elucidate the best indications for the ever-expanding list of systemic therapeutic modalities. We believe that basic research using animal models and PNET cell lines will yield novel insights into human PNETs.

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