The endocrinology of stress: Cortisol and beyond.

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Introduction

Stress is an inevitable part of life, influencing various physiological processes through complex interactions between the brain and the body. The endocrine system plays a central role in the stress response, with cortisol being a key hormone involved. However, the impact of stress extends beyond cortisol, involving a network of hormones and signaling pathways. Understanding the endocrinology of stress is essential for comprehending its effects on health and well-being [1].

Cortisol, often referred to as the "stress hormone," is produced by the adrenal glands in response to stress. It plays a crucial role in mobilizing energy resources and regulating immune function. Cortisol secretion follows a diurnal rhythm, with levels typically peaking in the morning and declining throughout the day. Cortisol promotes the breakdown of glycogen into glucose, providing a rapid energy source for the body during times of stress. It also stimulates gluconeogenesis, the synthesis of glucose from non-carbohydrate sources such as amino acids and fatty acids [2].

While cortisol has anti-inflammatory effects in the short term, chronic elevation of cortisol levels can suppress immune function, increasing susceptibility to infections and impairing wound healing. Cortisol is a central component of the Hypothalamic-Pituitary-Adrenal (HPA) axis, which regulates the body's response to stress. In response to stressors, the hypothalamus releases Corticotropin-Releasing Hormone (CRH), which stimulates the anterior pituitary gland to release Adrenocorticotropic Hormone (ACTH). ACTH, in turn, stimulates the adrenal glands to produce and release cortisol [3].

While cortisol plays a prominent role in the stress response, other hormones are also involved, interacting with cortisol to orchestrate a coordinated physiological response to stress. These catecholamines are released from the adrenal medulla in response to acute stress, rapidly increasing heart rate, blood pressure, and respiratory rate. They also promote the mobilization of glucose and fatty acids to provide energy for the "fight or flight" response [4].

Often referred to as the "bonding hormone," oxytocin is involved in social bonding, trust, and maternal behavior. It also plays a role in attenuating the stress response, promoting relaxation, and reducing anxiety. Dehydroepiandrosterone (DHEA) and its sulfate ester (DHEA-S) are adrenal steroids that exhibit anti-glucocorticoid effects, counteracting some of the negative effects of cortisol on the body. They also have neuroprotective and anti-inflammatory properties [5,6].

Thyroid hormones influence metabolism and energy expenditure, modulating the body's response to stress. Thyroid dysfunction can affect the stress response and exacerbate stress-related symptoms. While the stress response is a vital adaptive mechanism, chronic or excessive stress can have detrimental effects on health, contributing to the development and progression of various diseases [7].

Chronic stress is associated with an increased risk of hypertension, atherosclerosis, and heart disease. Dysregulation of cortisol and other stress hormones can promote inflammation, endothelial dysfunction, and dyslipidemia, contributing to cardiovascular pathology. Prolonged exposure to elevated cortisol levels can lead to insulin resistance, abdominal obesity, and dyslipidemia, collectively known as metabolic syndrome. These metabolic changes increase the risk of type 2 diabetes and cardiovascular disease [8].

Chronic stress is a significant risk factor for anxiety disorders, depression, and Post-Traumatic Stress Disorder (PTSD). Dysregulation of the HPA axis and alterations in neurotransmitter signaling contribute to the development of these psychiatric conditions. Prolonged stress suppresses immune function, increasing susceptibility to infections and impairing the body's ability to mount an effective immune response. Chronic inflammation associated with stress contributes to the pathogenesis of autoimmune diseases and exacerbates inflammatory conditions [9].

Physical activity has been shown to attenuate the physiological response to stress, improve mood, and enhance resilience to stressors. Exercise also promotes the release of endorphins, neurotransmitters that have analgesic and mood-enhancing effects. Adopting a balanced diet, getting adequate sleep, and avoiding excessive alcohol and caffeine consumption can support adrenal health and optimize hormone production. Strong social connections and supportive relationships buffer the effects of stress, promoting emotional well-being and reducing the risk of stress-related disorders [10].

Conclusion

The endocrinology of stress encompasses a complex interplay of hormones and signaling pathways that orchestrate the body's response to stressors. While cortisol plays a central role

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in the stress response, other hormones, such as epinephrine, oxytocin, and DHEA, also contribute to the adaptive physiological changes that occur during stress. Chronic or excessive stress can disrupt hormonal balance and contribute to the development of various health problems, highlighting the importance of stress management and lifestyle interventions in promoting resilience and well-being.

References

1. Athanasiou N, Bogdanis GC, Mastorakos G. Endocrine responses of the stress system to different types of exercise. Rev Endocr Metab Disord. 2023;24(2):251-66.
2. Bornstein SR, Allolio B, Arlt W, et al. Diagnosis and treatment of primary adrenal insufficiency: an endocrine society clinical practice guideline. J Clin Endocrinol Metab. 2016;101(2):364-89.
3. Joseph JJ, Golden SH. Cortisol dysregulation: the bidirectional link between stress, depression, and type 2 diabetes mellitus. Ann N Y Acad Sci. 2017;1391(1):20-34.
4. Rankin AM, Garza R, Byrd-Craven J. The endocrinology of female friendships: Cortisol and progesterone attunement after separation. Biol Psychol. 2021;161:108059.
5. Dušková M, Vašáková J, Dušková J, et al. The role of stress hormones in dental management behavior problems. Physiol Res. 2017;66:S317-22.
6. De Kloet ER, Otte C, Kumsta R, et al. Stress and depression: a crucial role of the mineralocorticoid receptor. J Neuroendocrinol. 2016;28(8).
7. Prete A, Yan Q, Al-Tarrah K, et al. The cortisol stress response induced by surgery: A systematic review and meta-analysis. Clin Endocrinol (Oxf). 2018;89(5):554-67.
8. Canuto R, Garcez A, Spritzer PM, et al. Associations of perceived stress and salivary cortisol with the snack and fast-food dietary pattern in women shift workers. Stress. 2021;24(6):763-71.
9. Arlt W, Baldeweg SE, Pearce SH, et al. Endocrinology in the time of COVID-19: Management of adrenal insufficiency. Eur J Endocrinol. 2020;183(1):G25-32.
10. Khoo B, Boshier PR, Freethy A, et al. Redefining the stress cortisol response to surgery. Clin Endocrinol (Oxf). 2017;87(5):451-8.

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