

Interpretive Guide for Adrenal Stress



Measurement of Adrenal Hormones in Saliva

The adrenal hormones, cortisol and dehydroepiandrosterone (DHEA) are steroids produced in the adrenal cortex via the pathway outlined in Figure 1. They are actively involved in the body's development, growth, immune response, and cardiovascular function. They affect carbohydrate, protein, and lipid metabolism, serve as anti-inflammatory agents, modulate thyroid function, and increase resistance to stress. Thus, changing amounts of DHEA and cortisol may signal important alterations in adrenal function that can profoundly affect an individual's energy levels, emotional state, disease resistance, and general sense of well-being.

About 1-10% of the steroids in the blood are in unbound, or free form. The rest are bound to carrier proteins such as cortisol-binding globulin, sex hormone-binding globulin, and albumin. Individual variations in binding protein affinities leads to primary endocrine abnormalities (1). Since only unbound steroids can freely diffuse into various target tissues in the body, they are the only hormones that are considered biologically active. Saliva testing measures the free-circulating, biologically active hormones (2).

Circadian Rhythm of Cortisol

The circadian rhythm of cortisol is regulated by the sleep-wake cycle. Secretions are characterized by a steep increase in the morning, peaking at approximately 8 a.m., followed by a gradual tapering off until about midnight, when circulating levels are at their lowest (Fig. 2). Episodic secretion of cortisol is caused by the intermittent transformation of cortisol from its precursors in the adrenal cortex stimulated by adrenocorticotropic hormone (ACTH) (3).

Patterns of Adaptive Responses

When forced to respond to continued, chronic stress the adrenal glands enter a compensated phase in which the production of the stress hormones is divergent. Because of the difference in response to ACTH, the production of DHEA falls as cortisol remains elevated. The process is shown graphically in Figure 3 where the initial stress response is labeled "A1". The negative feedback of cortisol on the hypothalamus is lost as higher cortisol is required to shut down adrenal responses and bring ACTH into the normal range.

Stress Responses of Cortisol and DHEA

Later phases of compensated response may go through the progression from "A2" to "A5". The progression has been called 'stress fixation'. Output of DHEA falls from high to normal to low followed by the same progression for cortisol. If the stress is prolonged, the production of both hormones falls into the sector labeled "C". Individuals affected with Addison's disease where the adrenals are unable to produce stress hormones have values that fall into the "C" sector. The rare finding of elevated DHEA with normal or low cortisol (Type "B") is genetically determined and these individuals should avoid high stress occupations.

Figure 1: Biosynthesis of Steroid Hormones

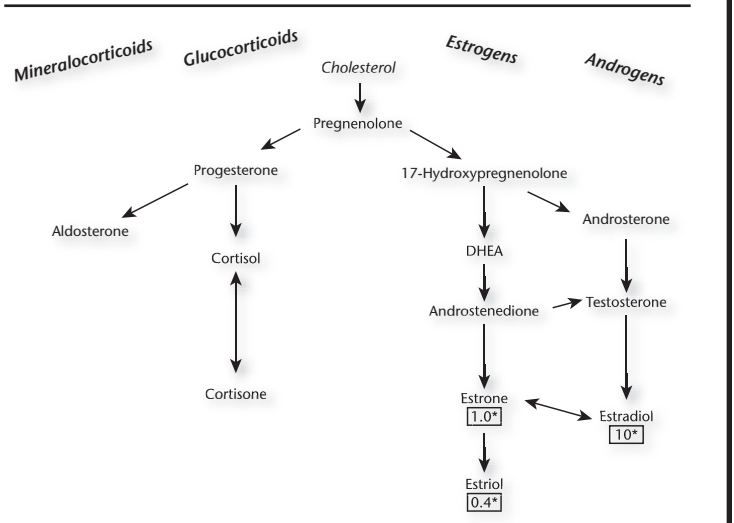


Figure 2: Circadian Cortisol Rhythm

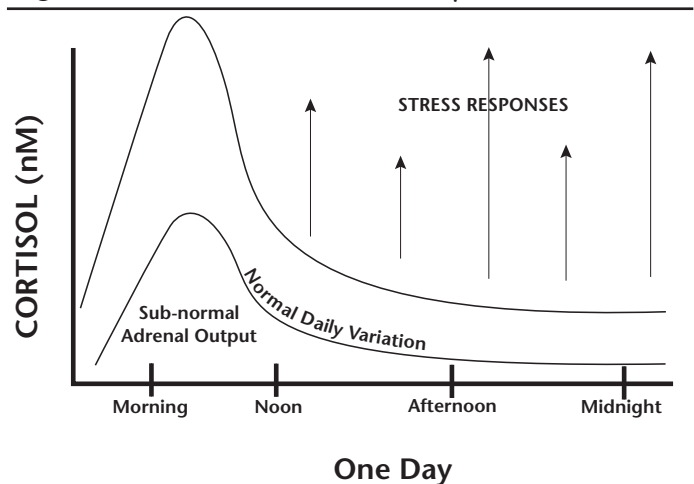
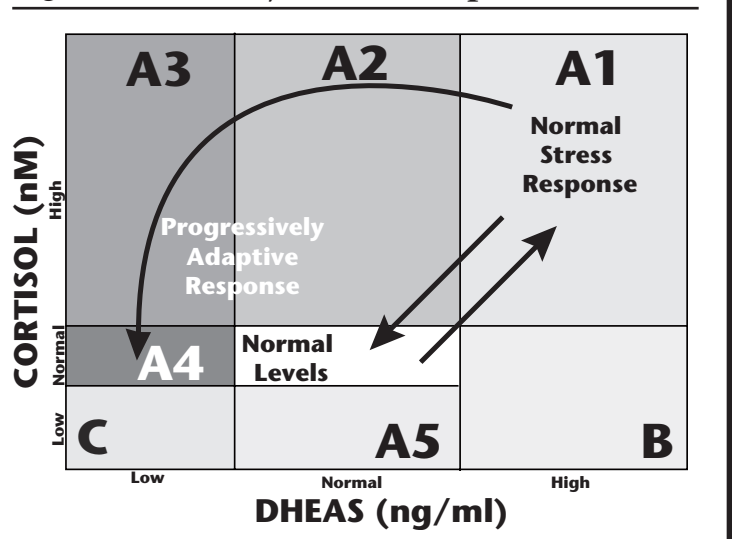


Figure 3: Phases of Adrenal Adaption



Signs of Adrenal Maladaption

Impaired energy production (insulin sensitivity drops)
 Reduction in glucose utilization and in amino acids due to enhanced gluconeogenesis
 Increased bone resorption and osteoporosis
 Fat accumulation at the waist
 Increased protein breakdown
 Salt and water retention
 General immune suppression
 Increased rate of infection
 Reduced vitality
 Hunger

Adrenal Support and Nutritional Factors in The Stress Response

Administration of DHEA can help overcome the loss of adrenal output and the precursor of both DHEA and cortisol, pregnenolone may be added to support adrenal function. Muscle protein breakdown caused by increased stress hormones can be reduced by use of supplemental amino acids (4). Increased adrenal activity also leads to greater loss of B-complex vitamins that may need to be replaced by supplementation. Finally, vitamin C is rapidly diminished by the adrenal stress response and may need to be added in gram amounts to prevent tissue depletion.

Omega-6 fatty acids are specifically depleted in individuals with high cortisol output (5). Dietary supplements of linoleic or gamma-linolenic may be used to replenish tissue status of these fatty acids, but there is an important question of balance with the omega-3 family in order to maintain the proper tissue response to challenges. Patients with elevated cortisol may need to be evaluated for polyunsaturated fatty acid status.

Health Conditions Associated with the Stress Response

- Stress Intolerance
- Depression
- Chronic Fatigue
- Insomnia
- Allergies
- Osteoporosis
- Hypothyroidism
- PMS (Premenstrual Syndrome)
- Accelerated Aging
- Anxiety
- Poor Immune Function
- Obesity
- Fibromyalgia
- Glucose Intolerance
- Yeast Overgrowth

References

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2. Stahl F, Dorner G. Responses of salivary cortisol levels to stress-situations. *Endokrinologie*, 1982; 80:158-62.
3. Jusko WJ, Slaunwhite WR, Jr., Aceto T, Jr. Partial pharmacodynamic model for the circadian-episodic secretion of cortisol in man. *J Clin Endocrinol Metab*, 1975; 40:278-89.
4. Hammarqvist F, von der Decken A, Vinnars E, Wernerman J. Stress hormones and amino acids infusion in healthy volunteers: short-term effects on protein synthesis and amino acid metabolism in skeletal muscle. *Metabolism*, 1994; 43:1158-63.
5. Williams LL, Kiecolt-Glaser JK, Horrocks LA, Hillhouse JT, Glaser R. Quantitative association between altered plasma esterified omega-6 fatty acid proportions and psychological stress. *Prostaglandins Leukot Essent Fatty Acids*, 1992; 47:165-70.

Adrenal Stress Support Guidelines*

Test Results (Noon - PM Averages)			Adrenal support protocols using hormones, extracts, and vitamins				
Total Cortisol	DHEA	Adaption Phase	Pregnenolone	DHEA	Ginseng ^o	Licorice root ^o	B-Vitamins
High	High	A1			+		^
High	Normal	A2		+	++		^
High	Low	A3		++	+++		^
Normal	High	B			++		
Normal	Low	A4	+	++	++		^
Low	High	B			++		
Low	Normal	A5		+		++	
Low	Low	C	+++	+++	+++	+++	^

*This table is provided as a guide to potential ways that have been found to be beneficial when abnormal hormone patterns are found. Plus marks indicate when intervention is indicated for the various patterns and greater number of marks indicate higher level of support may be needed. Nutritional support for the adrenal glands may include 2000- 5000 mg vitamin C and minerals, including 20 mg zinc, 200 mg magnesium, and 400 mg calcium. Adrenal glandular extract may be added to assure return to normalcy for some abnormal patterns. All of these interventions should be accompanied by lifestyle modifications, including reduction of stress levels, increased exercise, relaxation, and quiet time.
 ^ 50 mg B-complex with 1000 mg pantothenic acid and 200 mg biotin.
^o Licorice root contains glycyrrhizin, a substance which extends the half-life of cortisol secreted by the adrenal cortex. The adaptogenic effects of Siberian ginseng can help to normalize elevated output of DHEA and cortisol.

