STRESS-PROOF YOUR BRAIN

Craig E. Geis, MBA, MA, Psychology

Abstract

This paper is intended to be a brief discussion on how the hormone cortisol affects the brain. Cortisol is produced naturally in the acute stress response. The article also discusses ways to stress-proof your brain. The Human Factors: Error & Threat Management Course covers stress in depth and its affect on performance. Please refer to the course text for additional information.

If you are experiencing impaired concentration and memory, poor quality sleep or mood, your brain may be suffering from the detrimental effects of stress. Relatively minor symptoms such as mild anxiety or irritability may not catch your attention or cause you concern. However, without proper intervention, stress can produce a progressive deterioration of brain function culminating in serious conditions such as depression and dementia. How does stress cause such damage? By stimulating the body to produce excessive levels of a hormone called cortisol.

To understand this process and what we can do about it, a little background information is in order. When we think of the word "stress", mental-emotional strain usually comes to mind. Anxiety, fear, anger and frustration do, indeed, qualify as stress. And a type of mental stress called *concept shifting* is probably the most important type of stress experienced by people on a daily basis. Concept shifting is the action of changing the focus of your attention from one thing to another. Mental-emotional stress is extremely important. However, it is not the only type of stress. Excessive levels of any of the following are also types of stress: sound, light, certain chemicals, fatigue, starvation, acute illness, pain, tissue injury (with or without pain), trauma, surgery, long airplane flights, heat, cold, and deviations from normal blood sugar levels. The thing that qualifies all these as stress is their common ability to activate the body's stress response. It does not matter if the stress is mental-emotional, physiologic or environmental. The body responds in the same way. What happens when we experience stress is the following: specific areas of the brain become activated, resulting in the release of the hormone ACTH from the pituitary gland. ACTH travels through the bloodstream to the pair of adrenal glands, which are located above the kidneys. The adrenal glands respond by secreting cortisol and DHEA into the bloodstream. These two

hormones circulate throughout the body exerting a powerful influence on virtually every tissue. The body produces these hormones on a continual basis. Cortisol is secreted in a distinct diurnal (24 hour) rhythm with circulating levels being highest in early morning and gradually declining throughout the day. When the body experiences stress, cortisol and DHEA levels rise above resting baseline amounts. Increased production of these hormones enables the body to better respond to the stress, largely by altering protein and carbohydrate metabolism. This is fine when it occurs in short episodes. When the stress is gone, the pituitary gland will register that the elevated stress hormone levels are no longer needed and will decrease their output from the adrenal glands via a reduction in ACTH stimulation.

It is when stress becomes chronic that problems begin. With prolonged stress, the body prefers to make greater amounts of cortisol and subnormal levels of DHEA. This hormone imbalance puts the body into a catabolic state. More bad news is the fact that even after the stress ends, the effects may continue. What happens is that with prolonged elevation of cortisol, the brain loses its sensitivity to cortisol and can no longer monitor its circulating level. The brain therefore becomes powerless to down-regulate cortisol production. A continual state of stress response, with elevated cortisol and depressed DHEA output, becomes the norm. Remember that cortisol is secreted in a circadian rhythm. Elevated midnight levels of cortisol are characteristic of this state of maladaptation to stress.

Excessive levels of cortisol interfere with brain function in a number of ways. Cortisol impairs glucose transport and utilization by brain cells. Circulating glucose or blood sugar is the main energy source of the brain. When the brain's fuel supply is interrupted by high cortisol levels, impairment of learning, memory and mood can result. What's more, this reduction in energy supply to brain cells weakens them, making them more vulnerable to toxic insult. The hippocampus is a part of the brain that is particularly sensitive to the effects of elevated cortisol levels. This is the area of the brain that is damaged in Alzheimer's disease patients. In fact, people with Alzheimer's disease have been found to have elevated cortisol and reduced DHEA levels. Another line of evidence supporting the causative role of cortisol in dementia comes from animal studies. Rats injected with cortisol cannot remember how to find their way through a familiar maze. Upon autopsy, they are found to have signs of physical brain damage.

Cortisol can contribute to brain damage in other ways. It increases the permeability of the blood-brain barrier. In a normal healthy state, the tissue separating the brain from the bloodstream is very selective in regard to the compounds it allows to cross into the brain. This serves to protect the brain from exposure to potentially damaging chemicals. Under stress, this barrier weakens, allowing toxins in the blood access to the

brain. This toxic effect is multiplied by cortisol's inhibition of detoxication enzymes. Under the influence of high cortisol levels, the body winds up accumulating toxins that would normally be eliminated. What's more, cortisol interferes with the chelating function of the protein metallothionein. This results in greater accumulation of heavy metals, which can damage the brain.

Elevated nighttime cortisol levels interfere with R.E.M. sleep, which impairs mental regeneration and produces fatigue. It also inhibits growth hormone production resulting in impaired regeneration of physical structures. The net effect is acceleration of the aging process. Additionally, depression is a common consequence of excess midnight levels of cortisol.

Now that we see the damage cortisol can do to the brain, what can be done about it? Plenty!

There are various nutrients that can minimize the harmful effects of cortisol. These include biotin; vitamin C; pantothenic acid; vitamin B6; zinc; bioflavanoids; gamma linolenic acid; fish oils; gingko biloba; grape seed extract; acetyl-L-carnitine; tyrosine; beta 1, 3-D glucan; Siberian ginseng; N.A.D.H.; and other antioxidants including alpha lipoic acid; vitamin E and coenzyme Q10.

The primary focus, however, should be on lowering cortisol levels. The first step in this process is to remove the precipitating stress. If mental-emotional stress is a factor, then specific techniques such as guided imagery can be used to deal with this. A special technique called *"Cut-Thru"*, developed by the Institute of Heart Math, has been shown in scientific research to be very effective. *Cut-Thru* is a simple, quick relaxation method which has been found to result in a 23% reduction of cortisol and 100% increase of DHEA in one month's time. Meditation, tai chi, and aerobic exercise are also effective in lowering cortisol levels.

One of the most common sources of stress is dysglycemia or poor control of blood sugar levels. Dysglycemia usually results from eating a relative excess of carbohydrates and not enough protein. Cereal for breakfast, a donut in the afternoon, pasta for dinner, and your cortisol levels are through the roof. Dietary carbohydrates stimulate release of the hormone insulin which, in turn, results in an increase in cortisol levels. When dietary carbohydrates are a cause of stress, consuming a good balance of carbohydrate and protein at each meal is essential. A good ratio is about 2 grams of carbohydrate for every 1 gram of protein. The source of carbohydrate should be of low glycemic index - this means mostly unrefined. Supplementation of chromium and vanadium to aid blood

sugar regulation is also important. Suffice it to say, whatever stress is present needs to be eliminated or minimized in order to restore cortisol levels to normal.

When DHEA levels are low, it is a good idea to take supplements of DHEA. DHEA protects brain cells from damage. Ideally, exogenous source DHEA is only needed for several months until a normal stress response mechanism can be restored and the body starts to produce normal levels of DHEA on its own.

When midnight cortisol levels are elevated, supplementation of an additional nutrient is indicated. High midnight cortisol levels denote stress maladaptation - the loss of the negative feedback inhibition whereby the brain and pituitary gland down-regulate inappropriately elevated cortisol. Supplements of phosphatidylserine have been found to result in reduction of midnight cortisol levels. Incorporation of phosphatidylserine into the membranes of brain cells apparently restores sensitivity to cortisol receptors. Another similar compound, phosphorylated serine, can accomplish the same job for less money.

The best way to determine if your symptoms are due to stress is to take an Adrenal Stress Index test. This laboratory test utilizes saliva samples to measure cortisol and DHEA levels. The patient collects four samples over the course of a typical day. The laboratory uses these four samples to construct a circadian rhythm of cortisol output. Treatment can then be customized based on these results.

Stress can indeed impair brain function. Other important factors are nutrient deficiencies and chemical toxicity. These also can be evaluated with laboratory tests. Appropriate treatments can then be implemented.

Note: This article is intended to be informative only. Please consult your physician before taking any supplements or medication.