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STRESS

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INTRODUCTION

Selye defined stress as "the nonspecific response of the body to any demand made upon it" and called this response the general adaption syndrome (G.A.S.). The G.A.S. consists of three stages: 1) the alarm reaction, 2) resistance stage, 3) exhaustion stage. The mechanisms of stress have been substantiated, but the nutritional consequence has not been fully appreciated or explored. The purpose of this paper is to discuss the dynamic nutritional changes that occur during the various stages, and the use of hair tissue mineral analysis (HTMA) as a theoretical model for determining the individual stages of stress.

Additional Stages of Stress

An expansion to Selye's three stages of stress can be proposed to include two additional stages, the recovery stage and the adaption stage. Therefore, the G.A.S. could include:

1 - The alarm stage
2 - The resistance stage
3 - The recovery stage
4 - The adaption stage
5 - The exhaustion stage

The recovery stage (3) can be appropriately added since most of the everyday stress reactions are followed by recovery rather than exhaustion; otherwise, every stressor would be devastating. The adaption stage (4) is added to include Selye's description of "diseases of adaption." In this stage the body does not recover or exhaust, but adapts to a stage of stress that may result in chronic disease conditions such as ulcers, heart disease, etc. The exhaustion stage (when the body ultimately becomes exhausted due to an inability to recover from continued, chronic, diseased of adaption or due to mal-adaptation) has been moved to number 5.

Endocrine Response to Stress

We should first recognize that all stress is not bad for the body. Selye aptly described this difference as "stress and distress." Human beings are constantly under stress. It is both inescapable and indispensable to life. Selye equated being stress free with death. Some types of stress can be motivating and positive. Distress, however, is destructive to the body and if prolonged can lead to physical deterioration.

One of the first responses to stress is a sympathetic neuro-endocrine discharge mediated by the hypothalamus. This stimulates the pituitary to release thyroid stimulating hormone (TSH), antidiuretic hormone (ADH), andrenocorticotrophic hormone (ACTH), and growth hormone (GH). These sympathetic neuro-endocrine reactions produce an increase in cellular metabolic activity throughout the body. This results in a number of reactions, such as increased cellular uptake of amino acids, peripheral protein breakdown, and decreased peripheral response to insulin to mention only a few. The resulting increase in body temperature coincides with the increased secretion of aldosterone and ADH. The adrenal glands become enlarged, causing the thymus and other lymphatic tissue to shrink, and inflammation develops. Essentially, these are the basic mechanisms involved in the alarm stage of stress.

The resistance stage consists of continued sympathetic stimulation. Anti-inflammatory hormones (cortisol), are secreted in order to control the inflammation. Because cortisol produces tissue breakdown, or catabolism, and raises blood sugar, it is therefore referred to as a gluco-corticoid hormone. As the stress is brought under control, increased stimulation of the sympathetic neuro-endocrine system abates, tissue repair takes place, and normal function returns (recovery).

This paper proposes that any stage of the G.A.S. can result in a disease state due to mal-adaptation, or the inability of the body to proceed from one stage to another. As an example, if a person cannot progress beyond the alarm stage of stress, then this stage becomes the disease, i.e. an inflammatory process. If a person cannot progress through the resistance stage, then catabolism becomes dominant, resulting in chronic debilitating diseases.

These stages may be reflected in tissue mineral patterns found in the hair, which can aid in determining the nutritional requirements during the various stages of the G.A.S.

HTMA Indications Of The G.A.S.

The first stage of stress is the alarm reaction. A sympathetic neuro- endocrine response occurs that produces an increase in the production of the adrenal mineralcorticoid aldosterone and antidiuretic hormone (ADH). This produces an increase in sodium and water retention. The alarm stage of stress is indicated by an increased sodium/potassium ratio equal to or greater than 5:1. This HTMA pattern is indicative of an inflammatory process, which can presumably affect the weakest organ or tissue, resulting in gastritis, diverticulitis, colitis, sinusitis, arthritis, etc.

During the second stage of stress, resistance, anti-inflammatory hormones become dominant, reducing inflammation. The principle adrenal hormone involves the glucocorticoids (GC). The GC hormones are catabolic; they result in protein breakdown and increased gluconeogenesis. The GC hormones affect a low sodium/potassium ratio, less than 2.4:1. If the body does not proceed with the next stage, then the resistance stage becomes chronic. This results in chronic deterioration and debilitation.

If the body responds normally, the sodium/ potassium ratio will return to normal indicating the recovery stage. If the body stays in a chronic resistance stage of stress, eventually exhaustion will occur.

Nutritional Requirements During The G.A.S.

As mentioned previously, during the alarm stage of stress, sodium retention occurs. This in turn results in magnesium, potassium, and zinc loss, or increased requirements. Loss of these minerals may be a requirement for the initiation of the alarm reaction. Vitamins C, D, E,

B1, B6, B12; and the minerals copper, cobalt, and calcium are also required for this reaction to take place. Nutritional deficiencies can produce an inability of the body to initiate the alarm reaction; thus the stressor would be overwhelming to the body. Increased requirements of vitamins A, B1, B2, B3, B5, B6 and vitamin C develop. These can be classified as anti-inflammatory nutrients and are required in sufficient amounts for progression to the resistance stage.

As the anti-inflammatory process (resistance stage) begins, glucocorticoids increase, resulting in an increase in tissue potassium. Losses or increased requirements for zinc, iron, manganese, and magnesium continue along with the loss of calcium and copper. In order for the recovery phase to ensue, there is a need for adequate amounts of the minerals calcium, magnesium, copper, cobalt, and selenium. Vitamins C, D, E, B1, B6, B12 and folic acid are also required.

Nutrients Required For The Alarm Reaction

Vitamins	Minerals
C	Calcium
D	Copper
E	Cobalt
B1	Sodium
B6	Copper
B12	Selenium

Nutrients Required For The Resistance Stage

Vitamins	Minerals
C	Potassium
A	Zinc
B1	Manganese
B2	Iron
B3	Magnesium
B5	
B6	

Nutrients Required For The Recovery Stage

Vitamins	Minerals
C	Calcium
D	Magnesium
E	Copper
B1	Cobalt
B6	Selenium
B12	
Folic acid	

This is a simplified view of the G.A.S. through changes in tissue mineral patterns. The mechanisms involved are much more complex and involve many cellular, biochemical processes that are too numerous to detail here. Briefly stated, not only physical changes but also emotional changes develop with each stage of the G.A.S.

HTMA may be developed as a useful tool in evaluating the various stages of stress. Since stress increases nutritional requirements, HTMA may also prove to be a valuable aid in determining individual nutritional requirements during G.A.S.