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Magnesium Deficiency, Inflammation and Nervous System Hyperexcitability

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The Diet-Induced Pro-Inflammatory State -

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The first five parts in this series detailed several factors contributing to the diet-induced pro-inflammatory state. In review, it should be clear that grains are pro-inflammatory on many levels. Among other things, they are acidic and contain omega-6 fatty acids that promote the production of inflammatory eicosanoids and cytokines. Fruits and vegetables are alkaline, and green vegetables, in particular, contain anti-inflammatory omega-3 fatty acids.

While fatty acids play the most obvious role in the inflammatory process, numerous other nutritional factors can promote inflammation. Magnesium is an example, and few of us understand its connection to inflammation. A 1994 R.J.Elin article, "Magnesium: The Fifth but Forgotten Electrolyte,"¹ emphasized our lack of focus on this potential problem.

Approximately 300 bodily enzymes require magnesium, which suggests that magnesium is vital for most cells and tissues of the body. As a consequence, magnesium deficiency can have far-reaching effects on

many different tissues, to the point that a leading researcher wrote an article on the subject: "Magnesium Deficiency: A Cause of Heterogeneous Disease in Humans."² Numerous conditions and symptoms can be promoted by magnesium deficiency, including osteoporosis; muscle dysfunction; depression; apathy; cardiac arrhythmia; hypertension; atherosclerosis; and even stress and aging.^{2,3}

No bodily system can escape without being insulted by magnesium; in fact, it is thought to promote genomic stability. It turns out that nearly all DNA synthetic and repair enzymes require magnesium.⁴

Inflammation and Nervous System Hyperexcitability

A recent article in *Magnesium Research* discusses inflammation and nervous system hyperexcitability in detail.⁷ (As it turns out, *Magnesium Research* is found in only 10 libraries in the United States, so it is not easy to acquire. I think every chiropractic college library should have it.)

Nervous system hyperexcitability caused by magnesium deficiency can manifest differently in different species, and even in the same species, as a result of strain, gender and age. With this in mind, consider what has been discovered about magnesium deficiency.

From previous articles, the terms "pro-inflammatory eicosanoids" and "cytokines" should be familiar. Magnesium deficiency has been shown to increase eicosanoid synthesis and cytokine release. Substance-P release from nociceptors also can occur, which helps to reinforce nociceptive and inflammatory responses. Cellular production of free radicals also occurs with magnesium deficiency. Clearly, numerous inflammatory responses have the potential to develop in the wake of magnesium deficiency.⁷

Concerning the nervous system, magnesium deficiency is known to increase sodium conductance, which results in an overactive nervous system, affecting both the peripheral and central nervous systems. Rude explains that muscles become hyperexcitable with magnesium insufficiency,² allowing them to become much more responsive to noxious stimuli. In the central nervous system, there is increased activity of excitatory transmitters, including acetylcholine, dopamine, norepinephrine, aspartate, and glutamate; and there is a simultaneous decrease in activity of inhibitory neuromediators including serotonin, GABA, taurine and melatonin.⁷ Concerning melatonin, it appears that magnesium adequacy is required for appropriate regulation,⁸ which has far-reaching implications concerning sleep issues, such as daytime fatigue.

Durlach explains that the body has numerous compensatory mechanisms that allow magnesium deficiency to go undetected, leading to the development of what he calls "latent nervous system hyperexcitability."⁷ In other words, a patient will already be deficient in magnesium prior to the development of symptoms. The exact manner in which nervous system hyperexcitability will manifest in a patient is not known, although as chiropractors, hyperexcitable muscles would be a likely finding.

So, we should not be surprised that Rude described magnesium deficiency as a cause of heterogenous disease in humans.² What should we do? Eat more fruits, veggies, and healthy meat, chicken, and fish, and take supplements.

Supplementation with Magnesium

Intakes below the recommended daily allowance (RDA) are common, if not the norm, in many countries, including the United States.^{4,5} The U.S. RDA for magnesium is 320 mg for women and 420 milligrams (mg) for men. At the turn of the century (1900), magnesium intake was estimated to be 475-500 mg per day,⁵ which suggests our intake has declined substantially.

Researchers suggest that for every 2.2 pounds (one kilogram) of body weight, we should ingest six mg of magnesium. Accordingly, a 150-pound man (70 kg) requires 420 mg/day, while a 200-pound man (90 kg) requires 540 mg/day. As most people in the U.S. are deficient in magnesium, it is suggested that we supplement five mg per kg of body weight to replenish what has been lost.⁴ Researchers have observed that between 950-1,020 mg of magnesium per day is required to create a positive magnesium balance.⁵

If you are presently taking a calcium supplement, it is important to add a magnesium supplement to your regimen. The current accepted balance of calcium/magnesium intake is 2:1. At present, the average intake of calcium in the U.S. is thought to be about 1,000 mg/day or greater (including supplements and fortified foods), but only about 250-350 mg of magnesium. This imbalance (i.e., about a 4:1 ratio of calcium/magnesium) is thought to reduce magnesium absorption and further enhance magnesium deficiency.⁶ So, for overall health, the nervous system, and to help reduce inflammation, consider adding a magnesium supplement to your diet. A nutritional adjustment with magnesium works best when taken about 30 minutes before eating a meal. If you are taking more than 300 mg per day, divide your supplementation dosage throughout the day; this will help prevent loose stools, the primary side-effect of magnesium ingestion.

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