March 2019 - Mid-Month Bonus Newsletter

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**Nutrient of the Month: N-Acetylcysteine (NAC)**

It would be hard not to appreciate N-acetylcysteine (NAC), long considered a precursor to the metabolic gold of glutathione, that versatile antioxidant found (in adequate levels, we hope) in fatty as well as aqueous body environments. Though acetylcysteine is not as potent an antioxidant as glutathione, it is a relatively safe and stable source of cysteine, deemed by many researchers the primary limiting amino acid in glutathione biosynthesis and tissue replenishment. NAC’s distinctive sharp smell is the result of providing precious reduced organic sulfur as well as methyl-containing acetyl groups.

By increasing cellular glutathione levels, NAC can facilitate the solubilization and detoxification of substances through supporting hepatic conjugation reactions, and has accordingly been used to help protect liver function during detoxification challenges. Through effects on multiple pathways of the immune response, it may help modulate inflammatory processes, and it has been employed as a mucolytic aid for supporting lung function. Recent study indicates that disrupting bacterial biofilm production may be one of its activities, with potential applications in urogenital, gastrointestinal, periodontal, and respiratory health. NAC may be helpful in maintaining a stable mood, and shows good potential for supporting neurocognitive function. Modulating the metabolism of neurotransmitters (especially dopamine and glutamate) may be an important mechanism by which NAC affects higher brain processes, including sensations of craving.

There is some evidence that the body’s capacity for synthesizing glutathione declines with aging and that aging may even, to some degree, represent a condition of cysteine deficiency, and glutathione production can be improved in older people through supplementation with sources of cysteine. (Because acetylcysteine is a relatively stable
form of cysteine, it is fairly commonly used in place of L-cysteine in studies.) In the elderly, higher glutathione levels correlate with experiencing less illness and greater subjective feelings of health. In older populations having plant-based diets and/or lower protein intakes, NAC may represent a particularly beneficial source of cysteine for improving glutathione status, and NAC supplementation have shown to improve immune and vascular functions and reduce oxidative stress in aging people.

Recent research has found that aging-related DNA mutations in hematopoietic stem cells (which become red and white blood cells) significantly increase the risk for cardiovascular and metabolic diseases. It is intriguing, therefore, that storing hematopoietic stem cells with NAC has been shown to reduce DNA damage in them and preserve their integrity, though further research is necessary to determine if there is any analogous effect of NAC on these stem cells within humans.

In its capacity to stabilize redox environments, NAC appears to help prevent cellular damage and aging that can lead to cell death or dysfunction. It has shown protective effects on insulin-producing pancreatic beta cells and oxygen-stressed heart cells in animals prone to insulin resistance, though these findings have not been confirmed in humans. In preclinical research, NAC has shown tissue-protective effects against a variety of substances and organisms, among them:

- the food browning agent acrylamide
- the artificial sweetener aspartame
- titanium dioxide nanoparticles
- Helicobacter pylori (recently hypothetically linked to Parkinson’s disease)
- the food preservative sodium nitrite
- excessive activity of hyaluronidase (enzyme involved in connective tissue integrity)

and there has also been limited use of NAC in humans exposed to common herbicides like glyphosate and paraquat.
How Flexible is Your Heart-Mind Connection?

Our brains constantly seek input about what’s happening out there, and senses stream information to help devise immediate and long-term responses, and the heart is integral to both. Electrical conduction in the heart is a functional extension of the central nervous system, and perception and interpretation of events deeply influences how heart function is regulated, especially as we get older—and not always in a bad way. Heart rate variability (HRV) is increasingly appreciated as a way of recognizing how well one resolves stresses encountered in life, and the degree to which chronic stress is wearing upon one’s resilience.

Though HRV is much less detailed than an electrocardiogram (EKG), it quantifies the interval between heart beats, and when analyzed over time, provides insight into how seamlessly this body-mind interface shifts gears when conditions change. Healthy heart muscle works in an efficient, coordinated manner to pump the greatest amount of blood per heart beat with the least effort, yet is easily able to swing into a different tempo when needed to accommodate adjustments in physical activity. (In both cases, good rebound capacity in the receiving blood vessels is necessary for maintaining efficiency.) The trick is that, in humans, part of this activity lies in anticipation and perception of need.

In a car, when speed is needed, greater weight on the gas pedal injects more air and fuel into the engine, and its pistons rotate more rapidly to produce more power; yet at a stop light, it automatically re-adjusts to a low idle speed. With chronic unresolved stress and biological aging, the heart and blood vessels may gradually lose the ability to function at a low idle, and the heart may lose its rhythmicity and/or creep towards a higher baseline speed—and the increased resulting blood pressure can cause blood vessels to lose their flexibility. For these reasons, HRV is seen not just as a measure of heart function, but also as an index of the ability to regulate emotional reactions. During either rest or difficult circumstances, HRV can draw attention to long-term coping mechanisms and whether or not there is chronic disequilibrium between sympathetic (the classic “fight or flight” response) and parasympathetic (“relax, feed, and breed”) inputs from the nervous system. A higher HRV generally signals greater confidence in addressing adversity, more along the lines of “I can handle this, it’s OK, I have strategies for dealing with this, I have choices, I’m going to figure something out,” while reduced HRV reflects less inner composure: “Oh, this is horrible, I have to do something about it right away but don’t know what, it’s so awful, what will I do, mayday!”

Especially during aging, maintaining a higher HRV may indicate more highly developed coping skills for dealing with challenges, and it appears to reflect better blood pressure control during psychological stress testing. Some researchers view HRV as a surrogate marker for aspects of mental health, as reduced HRV is associated with clinical depression and anxiety, and the extent of HRV reduction may coincide with severity of depression. Higher HRV appears to correlate with lower levels of the inflammatory markers C-reactive protein and interleukin-6, and in older people at cardiovascular risk, the combination of reduced HRV with increased resting heart rate may be a key indicator of compromised function and frailty.

Having physical and/or mental “emergency response” systems in place may be crucial for long-term maintenance of HRV—and the body-mind poise it represents. As one example, older depressed individuals who practiced Tai Chi for one hour 3 times weekly were able to improve measures of mood while also increasing HRV—a combination of effects not seen with anti-depressant medication. In a study comparing older adults, those with higher HRVs were found to routinely ‘screen out’ negative inputs like angry-appearing faces more effectively than those with lower HRVs; this strategy was not seen in younger adults. While aging can emphasize the effects of having (or not having) habitual coping mechanisms, poor-quality or disrupted sleep contributes to reduced HRV even in healthy younger people. Additionally, there is some evidence for a link between taking multiple medications and reduced HRV, though it is not yet known whether it is
Efficient function in a vehicle’s engine has much to do with receiving regular maintenance, and perhaps human hearts and minds are not dissimilar in that regard. The following may be useful for preserving a robust HRV:

- Enjoying physical activity regularly, including some that is relatively intense
- Finding body-mind integration techniques that appeal to and really work for each individual—martial arts, yoga, breathing exercises, dance, meditation, or others
- Avoidance of eating or using electronic devices for several hours before bed, and getting around 8 hours of restful sleep
- Getting a wearable heart monitor and using an app (such as EliteHRV, Polar Heart Rate Sensor, or Garmin Heart Rate Monitor) to study how one’s HRV responds to different situations and learn how to maintain/increase HRV