Maintaining Cognitive Health

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This is the fifth part in a series addressing the most common health concerns as we age. Previous parts have discussed cardiovascular disease, weight loss and blood sugar. In this installment, I will discuss cognitive health and the steps we can take to improve brain function as we age. Cognitive health is vital to independence, productivity and quality of life. The thought of losing cherished memories and the ability to be self-reliant makes dementia one of the most feared age-related conditions.

Cognitive health is dependent upon the proper function of brain cells—not only neurons but also cells known as astrocytes and microglia. Created primarily through differentiation of neural progenitor cells, neurons are electrically excitable cells that process and transmit information by electrical and chemical signaling. This signaling occurs through synapses, which are specialized connections with other cells. By releasing neurotransmitters that bind to specific chemical receptors, each neuron influences the action of other neurons in the brain, the peripheral nervous system and throughout the body. The type of receptor activated by each neurotransmitter determines the effect upon the target neuron.

It is estimated that there are approximately 1 quadrillion synapses in the brain of a three-year-old child, but that number declines substantially and then stabilizes by adulthood. For adults, estimates vary from 100 to 500 trillion synapses.1-2

Astrocytes: Helping Neurons Do Their Job

Astrocytes provide vital structural and nutrient support to neurons and help to control functional synapses. Another function performed by astrocytes includes uptake and metabolism of neurotransmitters. Aging reduces the antioxidant defense of astrocytes, which induces oxidative stress in these important cells. In response to brain injury, infections, oxidative stress and inflammation, neural progenitor cells differentiate preferentially into astrocytes rather than neurons. Although astrocytes normally serve important functions, excessive astrocyte expansion, known as astrogliosis, can prevent growth of neurons and interfere with proper damage repair.3-4

The Brain’s Immune System

Other important brain cells are the microglia, which are the brain’s counterpart of the immune cells known as macrophages. As the brain’s first line of defense against pathogens and inflammatory “debris,” microglia are constantly on the alert for damaged neurons, plaque and infectious agents in the central nervous system (CNS). Because antibodies from the rest of the body are not able to penetrate the blood-brain barrier and enter the brain, the microglia cells must take over this role and recognize foreign bodies, engulf them and act as antigen-presenting cells, which activate T-cells. Since this process must be accomplished quickly to prevent potentially fatal damage, microglia are extremely sensitive to even small pathological changes in the CNS.

Although they are neuroprotective in the young brain, microglia cells may be primed to react abnormally to stimuli in the aged brain, becoming neurotoxic and destructive during neurodegeneration. Microglia synthesize amyloid precursor protein (APP) in response to injury and
chronic inflammation. APP is converted to amyloid plaque, which can stimulate microglia to produce neurotoxic compounds such as cytokines, excitotoxin and lipophylic amines, which all cause neural damage.5 Furthermore, plaque in Alzheimer’s disease contain activated microglia. A study has shown that direct injection of beta-amyloid protein into brain tissue activates microglia, which generate free radicals, leading to chronic neuronal inflammation and reduction of the number of neurons.5

As even minor neuronal damage occurs during normal aging, microglia are transformed into enlarged and activated cells, which may accumulate and contribute to an increased risk of Alzheimer’s disease with advancing age by favoring neuritic plaque formation in susceptible patients.6 DNA damage and Advanced Glycation End Products (AGEs) that accumulate with aging are other factors that may contribute to age-associated microglial activation.7 Stimulated microglia also generate oxygen free radicals (ROS), which may have implications in several degenerative neurological diseases.8

Supporting Healthy Brain Cell Function

A number of nutrients have been shown to promote proper functioning of brain cells (neurons, microglia and astrocytes), thereby promoting enhanced cognitive function.

As the human body ages, reductions in the levels of growth factors leads to major declines in brain cell performance and degenerative diseases.9

Acetyl carnitine arginate is known to mimic the effect of nerve growth factor (NGF) and cause neurite outgrowth in a manner similar to that elicited to by nerve growth factor itself.10 Acetyl carnitine works synergistically with acetyl carnitine arginate to increase the effects of nerve growth factor on the outgrowth of neurites from brain cells; this increase was as much as 100 times greater than when just nerve growth factor itself was present.11 Synergy between acetyl carnitine arginate and acetyl carnitine has been demonstrated when both were tested separately and together on brain cells and found to be highly synergistic in the production of the neurotransmitters GABA, glutamate, somatostatin and other brain peptides.12

The reason the two carnitines work synergistically on brain cell regrowth is because acetyl carnitine creates nerve growth factor receptors for either nerve growth factor or its mimic acetyl carnitine arginate to act upon.11 So, one form of carnitine stimulated the growth of the receptors that NGF acted upon, thereby regrowing neurites, and the other carnitine molecule mimicked the effects of nerve growth factor itself.10-11

In addition, acetyl carnitine arginate protects neurons against the toxicity caused by the presence of beta amyloid plaque found in old brain cells.13 Beta amyloid production is strongly implicated in the development of Alzheimer’s disease and is found in great abundance in the brains of people with Alzheimer’s disease.

Like acetyl carnitine arginate and acetyl carnitine, uridine is important in supporting neuron health. Human brain cells when exposed to uridine for 4 days had increased neurite outgrowth and neurofilament expression.14 Orally administered uridine-5-monophosphate (UMP) given to aged rats increased the release of dopamine in the right striatum of their brains by 341 percent compared to a control group increase of 221 percent; this difference represents a 54-percent increase in the potassium-evoked release of dopamine in the brains of the rats fed 2.5 percent UMP in their diets. The levels of two biomarkers of neurite outgrowth, neurofilament-70 and neurofilament-M protein,
increased to 182 percent and 221 percent higher, respectively, than in the control rats. The results of this study demonstrated that even in old rats, oral uridine, as UMP, intake increases neurotransmitter release and neurite outgrowth in vivo.15

Gotu kola works with acetyl carnitine arginate, acetyl carnitine and uridine to improve brain health. When Gotu kola was administered to rats, it improved the animals’ learning and memory in a standard shuttle box avoidance and step through test. Brain levels of malondialdehyde (MDA), the most prominent final breakdown product of cell membrane damage, were reduced and brain levels of the endogenous antioxidant glutathione were increased.16

Ginkgo biloba is another neuroprotective substance that has protected neurons in rat brains deprived of oxygen.17 Ginkgo biloba extract also has been studied to evaluate the mental functions and quality of life in healthy subjects with no cognitive impairment. In a four-week, randomized, double-blind, placebo-controlled study, 66 healthy volunteers aged between 50 and 65 years and without age-associated cognitive impairment were divided into two groups. One group of 34 subjects received Ginkgo and the other group of 32 subjects received the placebo.

The results indicated that Ginkgo significantly improved self-estimated mental health as well as self-estimated quality of life. Ginkgo also improved other factors related to cognitive function including motor performance and emotional evaluation.18

To achieve optimal brain function, one must take cognitive enhancement a step beyond protecting neurons. It’s equally important to ensure proper functioning of astrocytes and microglia. One substance shown to control over-activation of microglia is vinpocetine. As mentioned previously, the excessive activation of microglia is associated with the development of inflammation that may lead to neurodegenerative diseases. In an experimental animal model of dementia, researchers induced neurodegenerative lesions in rats then administered vinpocetine intraperitoneally. The rats not given vinpocetine did poorly on behavioral tests, including impaired recognition of novel objects and a new social partner plus suppressed spatial learning performance in the Morris water maze. In rats given vinpocetine, the behavioral deficits were attenuated. Lesion-induced attention deficit and learning disabilities were markedly alleviated by vinpocetine. The researchers also studied brain changes in the animals and determined that vinpocetine significantly decreased lesion size and microglia activation.19

Vinpocetine also has been shown to protect astrocytes against hypoxic (low oxygen) injury in vitro. Administration of vinpocetine to cell cultures of astrocytes during hypoxia significantly decreased the number of dead cells. Vinpocetine also stimulated mitochondrial function and increased levels of intracellular ATP, the universal energy molecule. The researchers concluded that vinpocetine had a significant cell-protective effect on astrocytes in vitro.20

Carnitine also is essential to the proper functioning of astrocytes. In the brain, L-carnitine and acetyl-L-carnitine play important roles in cerebral bioenergetics and protect neurons through a variety of mechanisms including their antioxidant functions and their ability to modulate and promote synaptic neurotransmission. Acetyl-L-carnitine has been used successfully in chronic degenerative diseases of the brain and for slowing down the progression of mental deterioration, possibly due to both the cholinergic neuronal transmission activity of acetyl-L-carnitine and its ability to enhance metabolism in brain mitochondria.21
The beneficial effect of acetyl L-carnitine and L-carnitine on astrocytes involves the production of ketone bodies. Astrocytes are able to produce large amounts of ketone bodies, which are thought to supply adjacent neurons with easily transferable substrates for generation of energy. Thus, the L-carnitine and acetyl L-carnitine mediated uptake mechanism becomes the rate-limiting step for astrocyte ketogenesis.21

Another mechanism whereby acetyl L-carnitine improves the function of astrocytes is the activation of heat shock proteins. The heat shock response contributes to the protection of cells in a variety of human conditions including inflammation, neurodegenerative disorders and aging. Heme oxygenase-1 is a heat shock protein widely investigated for its protective effects against brain oxidative injury. The treatment of astrocytes with acetyl-L-carnitine induces heme oxygenase-1 in a dose- and time-dependent manner and protects the astrocytes from reactive oxygen species (ROS).22

Ginkgo biloba can also support improved astrocyte functioning. Gap junction communication between astrocytes plays an important role in the brain. To study the effect of Ginkgo on gap junction communication, researchers induced a state of oxygen deprivation (hypoxia) followed by reoxygenation (reoxygenation) by blocking the middle cerebral artery in rodents, which caused obvious neurological deficits in the animals. When Ginkgo biloba was administrated daily for 7 days, the neurological deficit was improved and other abnormalities that occurred after the hypoxia and reoxygenation returned to normal. Astrocyte gap junction intercellular communication also was measured during the study and hypoxia-reoxygenation induced a significant decrease in astrocyte gap junction intercellular communication. Pretreatment with Ginkgo biloba, however, significantly prevented the hypoxia-reoxygenation inhibition of gap junction intercellular communication, indicating that Ginkgo's neuroprotective effect could be due to its ability to enhance the gap junction communication between astrocytes.23

Given the essential role all of the above substances play in cognitive enhancement a two-step approach to optimal brain health can include supplementing with Extension IQ™ (which includes Ginkgo and vinpocetine along with other synergistic ingredients such as choline, huperzine-A, DMAE and L-phenylalanine) plus Neuron Growth Factors (NGF™), which combines acetyl L-carnitine arginate, acetyl L-carnitine, Gotu kola, Ginkgo biloba and uridine.

Additional Cognitive Support

Individuals who want to go one step further in protecting their cognitive health can add CDP Choline to their regimen. CDP Choline is a unique form of the essential nutrient choline that helps regulate bioelectrical activities in the brain.

CDP Choline is used to synthesize phospholipids, the essential building blocks of all biological membrane systems. Phosphatidylcholine, one of the primary phospholipids synthesized from CDP Choline, is an integral component of cellular membranes that adds strength and fluidity to cells. Phosphatidylcholine in brain cell membranes decreases with age. Studies indicate that CDP Choline supplementation may increase phosphatidylcholine synthesis and might reverse this age-related loss.24

Because of CDP Choline’s intermediary role in phosphatidylcholine synthesis, researchers theorized that it could restore memory function by repairing age-related changes within the brain neuronal membrane. CDP Choline’s potential for age-related memory loss was investigated in a double-blind, placebo-controlled, randomized trial involving 84 patients, mean age 72, with mild to moderate
memory deficits but no other cognitive dysfunctions. Memory loss was assessed using the Mini Mental State Examination (MMSE). After taking 1,000 mg CDP Choline daily for six weeks, subjects were assessed with the Randt Memory Test for changes in immediate recall, delayed recall and global memory efficiency. Global memory efficiency improved, primarily due to the subjects’ significantly improved ability to learn new information.

Conclusion

As we age, supporting the health of brain cells is crucial for sustaining optimal cognitive function. Consuming the brain-supportive substances found in Extension IQ and Neuron Growth Factors along with CDP Choline can produce excellent results.

Finally, when undertaking a cognitive-enhancing program, it is important to realize that many factors can affect brain health. Therefore, I also urge my patients to get eight hours of good quality sleep per night, consume abundant antioxidants in the diet to protect against free radicals, make certain the thyroid and adrenal glands are functioning properly and that blood sugar is under control. Exercising the brain by continually learning new skills can also be helpful.

References:


