THE BRAIN IMMUNE CONNECTION: STAYING WELL IN A TOXIC WORLD

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It's not simply time and poor nutrition that threaten the power of our brain and nervous system. The air we breathe, water we drink and soil our food is grown in are under assault from pesticides, industrial run-off, hormones, chemical residues and smoke. Many of the fish we eat are loaded with mercury — which even in low doses can damage neurological function. (Bauman, 2000; 23-24) And let's not overlook how the energy from power lines that feed our homes' electrical addiction may disturb our brains. Did someone mention cell phones? Toxic carriers for your flu vaccine? And who hasn't been touched by the tragedy of senile dementia, Alzheimer's, or the crippling, clinical depression of an otherwise promising young adult?

With challenges like these, we are simply being realistic when we consider what to feed our brain so that we can function effectively every day. Pertinent as well is what scientific researchers now call the brain-immune connection. If we hope to stay healthy and enjoy plenty of energy for work, family and the other passions of our lives, we need to promote the positive collaboration between our nervous and immune systems.

It may seem obvious today, but scientific proof for the intimate communications between the brain and our immune and endocrine systems is quite a recent phenomena. Not only does this new awareness allow us to better maintain our overall health, it has also fueled a revolution by proving that our emotions can be a result of various internal body functions — or dysfunction. This is of particular importance to women who have been historically subject to misdiagnosis and worse by a medical system that did not understand the relationship between feelings and health. As Candace Pert exclaims in *The Molecules of Emotion*, "The body is the unconscious mind! Repressed traumas caused by overwhelming emotion can be stored in a body part, thereafter affecting our ability to feel that part or even move it." (Pert; 1997; 141)

Classical immunologists traditionally scorned the notion that the immune system could be taught. Rather than thinking, immune cells were *responding* to circulating molecules — adhering to proteins protruding from cell surfaces, slipping into a cell's interior, triggering manufacture of additional molecules in the cell's protein factories and delivering the resulting antibodies to seek out, surround and destroy non-self invaders. Learning simply wasn't a factor. (Sternberg, 2001; 161) Beginning in the 1970's, a growing collection of research on brain-specific chemicals and hormones revealed that these substances affected immune cell function, and that immune-specific chemicals and hormones affected brain response, as well.

Looking backward, we can now see that a paradigm shift of tremendous proportion in the scientific community began with Hans Selye's groundbreaking research (1950s) into the biochemical nature of stress. The shift moved into high gear with Pert's discovery of opiate receptors in the brain in 1972 coupled with John Hughes and Hans Kosterlitz' breakthrough discovery in 1975 of the endogenous ligand endorphin, a peptide produced in the brain that fit the opiate receptor. This meant that what had previously been seen as the experience of localized pain relief was actually being mediated in the brain. (Pert; 1997; 70)

In the intervening thirty years, the discipline of psychoneuroimmunology has emerged as neurobiologists, psychologists, endocrinologists, and immunologists have begun to share information. The realization that brain function is modulated by numerous chemicals — in addition to classical neurotransmitters — has fueled the need to explore the implication of this knowledge to each of these fields. (Pert; 1997; 179)

By the early 1980's, the detection of (cytokine) interleukin-1 — a growth and differentiation factor for immune cells — in the brain sparked the revelation that these communication molecules could be key factors in maintaining the health of nerve cells as well as immune cells. (Sternberg,

2001; 82, 84) It was difficult, initially, to conceive that the action of ligands and receptors functioned as a second nervous system. This "chemical brain", explains Pert, operates in an expanded timeframe across greater distances. If we remember that before there were (mammalian) brains there were peptides, such as endorphins, it is easier to comprehend the idea of a chemical brain. While peptides may act as neurotransmitters — rapidly crossing synaptic gaps — they are more frequently found using the blood and cerebrospinal fluid to travel far and wide through extra-cellular space, triggering complex and fundamental processes inside the cells whose receptors they lock onto (Pert, 1997; 26-27).

Reality has been clarified. In *The Molecules of Emotion*, Pert engagingly traces the step-by-step laboratory science that documents how our major organ systems don't work in isolation from one another. Nor are they unaffected by what we think and feel. We have begun to understand how neurotransmitters are involved in immunoregulation.

For example, serotonin (5-HT) affects 1) T cell and NK cell activation, 2) delayed-type hypersensitivity responses, 3) production of chemotactic factors, and 4) natural immunity delivered by macrophages. Differing subtypes of 5-HT receptors are found on B and T cells and monocytes and macrophages. Dopamine encourages selective T cell deficits expressed variously including: 1) depressed delayed-type hypersensitivity, 2) reduced splenic T cell populations, and 3) diminished mixed-lymphocyte blastogenesis, while it enhances the lectin Concanavalin A's mitogenesis. Acetylcholine eases the release of pro-inflammatory cytokines by endotoxin-stimulated macrophages— demonstrating a role for the vagus nerve in prevention of septic shock. (Solomon; 2001; 9)

The implications of all this are not so surprising to the holistic healing community whose Mind/Body awareness is finally beginning to register on the radar of the scientific establishment. That our neural brain is in constant communication with our chemical brain is another way to understand that regardless of the specific health challenges we may face, our neural brain still heads up our body's *Joint Chiefs of Staff*.

It is the hypothalamus that serves as the overseer for this crucial biochemical dialogue. In addition to controlling the production and release of insulin, thyroid, stress, growth and sex hormones, this pea-sized organ also connects emotions to physical responses. Anger, depression and anxiety, for instance, are all mediated by chemical communication (neurotransmitters and neuropeptides) originating in the hypothalamus. (Lombard and Germano, 2000; 14) Recent research has revealed the flow of immuno-transmitters (i.e. cytokines) and neurotransmitters between the hypothalamus and the immune system. This allows the brain to have an effect on the activity level of white blood cells, lymph nodes and other immune organs, while brain metabolism is in turn mediated by information from the immune system. (Lombard and Germano, 2000; 14).

Not only have the last 20 years produced a flood of information on how the brain works, we are also reaping rewards from research that helps identify with more certainty what nutrients will best benefit our brains, among other body parts. Of primary importance in a brain nutrition program is to have a brain nutrition program. In the words of Dharma Singh Khalsa, M.D. this is "because *preventing* mental decline is much easier than *reversing* it." (Khalsa, 1999; 4). Khalsa is a leader in the practice of CAM (Complimentary and Alternative Medicine). "Often a new, improved attitude requires a new, improved biochemistry. […] Attitude and biochemistry create each other. I believe that doctors and patients should be very pragmatic and flexible about their philosophies of healing. They should […] accept healing wherever they find it." (Khalsa, 1999; 76)

Brain nutrition starts by feeding your brain to maximize the health of key neurotransmitters that control memory, focus, learning, energy and happiness. Four of the most important of these are acetylcholine, norepinephrine, serotonin,

and dopamine. Lecithin provides choline and helps your body to digest fats and produce bile acids. Dietary lecithin comes from soybeans and soybean oil, avocados, egg yolks, wheat germ, legumes (ie peanuts), salmon, liver, ham and whole wheat. Therapeutic dosages (2.5-3 grams 4X/day) may be necessary when brain function is already impaired. Vitamin C, B5 and B6 are key cofactors for acetylcholine. (Khalsa; 1997; 208-210)

Dopamine helps to improve mood, burn fat, increase sex drive, enhance immunity and promote longevity. Dopamine and norepinephrine both use the amino acids tyrosine and phenylalanine as building blocks. Other key ingredients helping in their manufacture include folic acid, magnesium, vitamins C and B12. (Khalsa; 1997; 212)

Serotonin is often characterized as the "feel good" neurotransmitter. Low levels can contribute to depression, autism, and increase our sensitivity to pain. Excessive levels can be dangerous which is why it's important not to mix prescription drugs that increase serotonin levels with dietary supplements and/or herbs that do the same. (Lombard and Germano; 2000; 57) Our brain needs tryptophan in order to produce serotonin. In order for the tryptophan to enter the brain, you need to eat high-carbohydrate, low protein meals, taking care to ingest the carbs first. (Khalsa; 1997; 214)

Two natural substances that can help increase serotonin levels (as well as up-regulating levels of other neuro-transmitters like acetylcholine and norepinephrine) are St. John's Wort and SAMe (s-adenosyl methionine).

In *The Brain Wellness Plan*, Dr. Jay Lombard and Carl Germano portray emerging nutritional therapies that may prevent and treat depression, autism, Alzheimer's, chronic fatigue, ADD, Multiple Sclerosis, Parkinson's and other neurologically based conditions as neuroimmunomodulation. (Lombard and Germano, 2000; 8) Neuro-immuno-modulators are specific nutrients that can be used to improve and support the flow of information between the brain and the immune system.

As might be expected, one important way to facilitate this information flow is to strengthen and support the circulation of blood while keeping the body's superhighways (arterial system) in good repair. Brain health starts with good housekeeping via the blood. When the blood moves efficiently to and through the brain we have a better chance of delivering critical nutrients and removing toxic substances. Impaired circulation is the principal culprit in approximately 20% of the cases of severe cognitive dysfunction in the elderly. (Khalsa; 1997; 199) As Candace Pert is fond of saying, "What's good for the heart is good for the head." The single worst thing we can do for our circulation, of course, is to eat too much fat. (Khalsa; 1997; 225)

Inflammation, impaired cellular function and lipid peroxidation are other processes that contribute to brain degeneration. To assure brain wellness, we want to find ways to avoid the ravages of inflammation, improve brain cell metabolism and decrease damage from free radicals. Let's look at how we can do this.

Our brains are particularly sensitive to free radical damage because the brain is 25% fat (Lombard and Germano, 2000; 24). Since fat molecules readily give up an electron when bombarded by a free radical, that tendency to oxidize compounds the damaging effects of free radicals. (Bauman, 1999; 4) Excessive immune activity in the brain, whether from disease, infection, toxic exposure, stress or aging, creates gangs of free radicals that can damage neurons and their mitochondria (energy producing molecules). We want to provide our brain with a plethora of antioxidants that can effectively navigate the blood-brain barrier to quell free radical activity and protect cell membrane and DNA integrity. (Bauman, 2000; 4)

Polyphenols, which include bioflavinoids, are remarkably suited to pairing up with a roving free radical to calm it down. They also are able to slow down the production of lipo-oxygenase, an enzyme that contributes to inflammatory effects and allergic response. (Lombard and Germano; 2000; 49). **Polyphenols** are readily

available from our food supply. Sources include: **green tea, red wine, berries, soybeans** and **brightly colored vegetables**. For added value, good polyphenol supplements include; **grape seed extract, pine bark extract, bilberry, ginkgo biloba** and **milk thistle.**

Vitamin E is a key player in any antioxidant protocol, particularly in brain health as it is an important fat-soluble antioxidant.

Ginko biloba helps to feed the hungry brain by increasing the cellular uptake of glucose and provides powerful antioxidant protection. Clinical trials have reported many positive benefits from its use in a variety of diseases and conditions. These benefits include better health, improved blood flow, reduced dizziness, improved memory, fewer headaches and a reduction in episodes of depression. ((Lombard and Germano, 2000; 50).

One of the most potent ways to combat inflammation is to increase our levels of omega-3 fatty acids (DHA, EPA and linoleic acid). DHA contributes to the build up of central nervous system lipids while discouraging the formation of more inflammatory prostaglandins and supporting nerve cell communications. **Omega-3s'** anti-inflammatory activity includes reducing the potentially harmful effects of arachidonic acid. DHA and phosphatidylserine (PS) improve cell membrane fluidity — important in letting nutrients in and allowing the efficient removal of metabolic waste products. PS improves inter-cellular communications and can increase the levels of acetylcholine and dopamine.

Produced by both the brain and the adrenal glands, **DHEA** contributes to intra-nervous system communications by supporting the growth and function of neuron dendrites. By partially regulating excessive cortisol production, DHEA helps protect the brain from damage due to this stress hormone. DHEA can also help moderate potentially dangerous cytokine levels that can exacerbate brain dysfunction. (Lombard and Germano; 2000; 51-52).

Mitochondria provide all our cells with the ATP that fuels our enzymatic processes. **Acetyl-L-carnitine** (ALC), **coenzyme Q10**, and **creatine** provide mitochondrial support. ALC assists in the transport and delivery of EFAs into cells. Once the fatty acids have pierced the cell wall, they can be used to provide energy and aid in structural repair. Dietary sources of ALC include meat and milk. CoenzymeQ10's antioxidant activity protects mitochondria cellular membranes from free radical damage. Creatine increases production of mitochondrial ATP. (Lombard and Germano; 2000; 54-55).

Following the guidelines noted here — along with an eating for health diet — and taking time to regularly detoxify from the assault on our biology that is the 21st century, we can nourish and protect both our brain and immune system and avoid the ravages of degenerative conditions.

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