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The Aging Brain Linda Aronson, DVM (2010)

Our Beardies are living longer lives. We view them as members of our families rather than only valuing them for their utility, but we also want to prolong their ability to work for and with us. There is increased attention to routine wellness checks that assess the various body systems for systemic illness; improved nutrition; and immunization against potentially fatal diseases thereby reducing their incidence. Owners are more conscious of the dangers of obesity and are more careful with the safety of their companions. We realize how draining pain can be and the benefits of addressing osteoarthritis pain early and aggressively. While this attention to the bodies of our dogs is paying off, fewer people seem to be addressing the needs of the aging brain. Many veterinarians seem reluctant to intervene on behalf of the brain, and owners may be leery of asking for help with changes they see, fearing they will be told there is no hope. That's a shame because we can be proactive and slow the pathologic aging of the brain and prolong not only the physical but emotional life of our dogs.

The deleterious effects of aging in dogs are lumped together under the term canine cognitive dysfunction (CD) or sometimes cognitive dysfunction syndrome. This includes disorientation; alterations in social and interactive behaviors; changes in locomotion - loss of control of the limbs, walking with a wide stance, walking into walls, inability to reverse, etc; change in sleep cycles including reversal of day for night; and inappropriate urination and/or defecation euphemistically referred to as loss of house training. In the early stages signs are more subtle, often there will be a slight change in sleep patterns, increased anxiety, increased neediness or aloof disengagement. While size of dog is a factor, studies have shown that 25% of dogs over age 10 show at least one sign of brain aging, and that 60% of dogs will show signs by the time they reach 15.

There are three basic processes which interact to produce CD: oxidative changes associated with free radical formation and other processes; lesions - including those made by amyloid formation the major change associated with human Alzheimer's disease; and shifts in oxygen and energy availability.

As any animal ages there is an increased expression of genes associated



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with stress and inflammation. That results in a loss of neurons in the hippocampus, the part of the brain primarily involved in learning by association, as well as a decrease in the expression of genes that affect the ability of the neurons to send and receive signals. It really is harder for old dogs to learn new tricks. Oxidative assault, illness or trauma cause inflammation or damage to neurons and this in turn affects the neurochemicals which allow communication between neurons. For efficient function you need a lot of neurons that can communicate efficiently and accurately. The best way to maintain these connections is to use them. Making and recalling molecular memories triggers a messenger system that stimulates a substance called brain-derived neurotrophic factor (BDNF) which ultimately enhances the growth of neurons that are powered by serotonin and norepinephrine (very important for normal behavior), protects them from toxic damage, and helps remodel receptors for improved nerve communication. In other words, use it or lose it.

Oxidative damage to the brain may result in deposition of beta amyloid plaques. If this becomes extensive it can physically disrupt communication between nerves and increasing the signs of CD. Oxidative stress appears to affect all major classes of molecules involved in nerve transmission. The energy needed for the brain to function is primarily provided by the breakdown of glucose which is stored as glycogen in special brain cells called astrocytes. If a dog is hypoglycemic or there is intense brain function - or during a seizure - the glycogen is converted to lactate, which can keep nerves firing for an additional 20 minutes. Ketone bodies and fatty acids may also provide alternative energy sources during hypoglycemia and help protect hippocampal neurons.

In humans with mild Alzheimer's disease supplementation with medium chain triglycerides (MCTs) resulted in improvement in a number of cognitive test measures. In 9 to 11 year old beagles a small study showed improved mitochondrial function and therefore improved energy metabolism in some brain neurons when they received MCTs. They also showed a reduction in the precursors of amyloid. The polyunsaturated fatty acids (PUFAs) arachidonic acid (ARA), docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) - the latter two found in abundance in fish oil - are important for early brain development and healthy functioning of the nerves of the brain. ARA is believed to protect hippocampal cells from oxidative stress. DHA may encourage specific associational learning. Low levels during gestation or lactation can have a profound effect on the behavior of



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the puppies, but it seems that DHA is important also for long term cognitive ability. Age-related cognitive decline seems to be associated with a decrease in PUFAs in the brain. MCTs will also increase levels of cerebral PUFAs.

So what can we do? At this point we are only just beginning to unravel what goes on in the aging brain, but we have some intriguing insights. Intermittent fasting induces the production of BDNF. Many of our Beardies choose to miss a meal, and maybe we should worry less, and imagine instead the improvement in learning that is going on.

The food companies have been paying attention. Hill's prescription diet b/d canine provides high levels of vitamins C and E as well as L-carnitine, an amino acid found in muscle meat, to reduce oxidative stress, increase energy availability to the brain and improve nerve signal transmission. The best results were seen if the dogs' environment was stimulating and rich during laboratory testing. Brain levels of BDNF in older dogs were close to those found in young ones. Purina's EN Canine diet uses MCTs and omega-3 and omega-6 fatty acids also hoping to reduce oxidative stress. I do worry about deterioration of EFAs in processed foods though, so I advise supplementing the diet with them. Coconut oil is a great source of MCTs, and my dogs get both that and fish oil.

SAM-e, s-adenosylmethionine, influences nerve-cell communication by increasing the activity of dopamine and serotonin, it also helps to maintain the structure and fluidity of nerve cell membranes potentially enhancing electrical activity from cell to cell. SAM-e reduces inflammation in joints and protects liver and kidney function. All of which make it a good choice for older dogs.

Another supplement that may help is Senilife (Ceva Sante Animale) which uses an antioxidant resveratrol, structural enhancers of nerve membranes and a coenzyme needed for neurotransmitter function. You will likely hear of others, but I've no experience with them.

For many vets the first line of attack on CD is selegiline (Anipryl). It inhibits the breakdown of the neurotransmitters - serotonin, norepinephrine and dopamine, the greatest effect being on dopamine. As a result there's more neurotransmitter stimulation of neurons, their communication (synapses) are maintained and BDNF can do its thing. Selegiline works best as a



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preventative or if it is given at the first signs of CD. If the dog exhibits non specific signs of increased anxiety tricyclic antidepressants (amitriptyline) or selective serotonin uptake inhibitors (Prozac) may help. They increase neuronal communication and keep nerve cells plump and active. If sleep cycle disruption is the only sign, melatonin at bedtime may rectify the situation.

Maintaining or increasing cognitive and physical stimulation is of utmost importance as dogs (and humans) age in order to maintain healthy brain function. Exercise should be matched to the dogs breed, behavior and health, but even arthritic dogs benefit from a walk and massage. Swimming and underwater treadmills provide great exercise with less strain on sore joints. If your old dog can no longer jump for a ball or Frisbee he can still chase a rolled ball. Rolling food toys or ones that make a noise maintains eye paw coordination, puzzle toys are great for encouraging thinking, and noisy toys may help dogs with reduced vision, while using odors can benefit those losing their hearing or sight. Amyloid deposits are found in the olfactory neurons as well as other parts of the brain, so encouraging your old Bearded Collie to follow scent paths or a nice meaty bone dragged through the grass is a therapy he'll love. Warming food or adding a warm broth (or green tripe) will help stimulate less active olfactory cells and encourage appetite if it is failing. Teach him new tricks, introduce the clicker if you haven't already, work on the old behaviors he knows too. Five minutes three or four times a day can provide a huge improvement. If you get up, encourage your dog to come with you.

Contrary to popular belief, adding a new puppy or older dog to the household can also provide helpful mental and physical stimulation. Just be sure the old dog can get away if the puppy is being a pest, they both need their down time and naps. Don't leave the older Bearded Collie home just because he's old and slow, do what it takes to keep him involved and get him out there.