

CDS in Aging Dogs: Managing CDS as a Canine Welfare Issue

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Abstract

Canine cognitive dysfunction refers to a neurodegenerative disease in aging dogs, characterized by a gradual decline in cognitive function. Clinically, CDS may cause behavioral changes such as disorientation in the home, altered interactions with owners and other people, changes in house training, sleep -wake cycles, reduced activity levels and reduced recognition of family members; impacting the human animal bond. (Manteca, 2011). The prevalence of CDS and its dietary and pharmacological treatment has been widely reviewed as interest in CDS as a welfare issue for elderly pets has grown. (Manteca, 2011) This paper will investigate the relationship between preventative care and its potential impact on improving the welfare of elderly pets. It will explore whether these considerations will, in practice and through owner education, address and improve the welfare of aging dogs.

Introduction and Overview

It is known that with increasing age, dogs develop a form of neurodegenerative disease having many similarities to age related cognitive impairment and Alzheimer's disease in humans. (Landsberg, 2005; Neilson, Hart, Cliff and Ruehl, 2001) In dogs as young as seven years of age, a decline in learning and memory has been demonstrated through a variety of neuropsychological tests. In spite of this, clinical cases of CDS are rarely diagnosed until the age of eleven. It has been posited that the reason for this is that owners are likely to rely on clinical observations such as disorientation, altered interactions with people or other pets, changes in sleep wake cycles, house soiling, and altered activity levels, rather than tests of learning and memory skills. (Landsberg, 2005) These clinical behavioral changes (as described by the acronym DISHA) are often the first sign to owners that reflect cognitive decline in aging pets, even though their pet may have suffered age dependent brain alterations at an earlier age. Improvements in nutrition, medical care and protection from accidental death have resulted in greater longevity, with many companion dogs living well into the elderly stages of life. With longevity comes age related degenerative changes in a number of organ systems. Key among these is degenerative changes in the brain resulting in noticeable impairment of learning and memory. (Neilson et al., 2001) A growing interest in understanding the prevalence and nature of signs of dysfunction in dogs related to impairment of learning and memory was underscored by the approval in 1998 of the dopaminergic and neuroprotective drug seligiline hydrochloride by the FDA Center for Veterinary Medicine for treatment of cognitive dysfunction syndrome in dogs. That CDS occurs earlier than we think, and that we may be able to prevent or curtail the early onset of neurodegenerative disease of the brain, preserve the relationship between owner and pet, and improve the welfare of elderly companion dogs is the subject of this discussion.

Problem Statement & Research Question

Assessing and maintaining cognitive and behavioral well being in senior pets requires special consideration since changes in anxiety levels and cognitive function may be complicated by other medical conditions, medication, sensory perception and previous learning.(Landsberg, DePorter and Araujo, 2011) Behavioral signs are often the first and sometimes only sign of pain, illness and cognitive decline. Therefore, family members need assistance in recognizing the significance of these changes and the importance of notifying their veterinarian as soon as possible. Early detection of behavioral changes associated with disease may create opportunities for diagnosis and treatment, potentially preventing further cognitive decline, increasing longevity, and addressing welfare issues sooner. In other words, can early intervention through owner education improve the welfare of aging dogs by offering preventive treatment options and setting realistic expectations with respect to behavioral changes associated with aging in senior pets?

Clinical Signs and Prevalence of CCDS

Clinically, cognitive dysfunction can result in a variety of behavioral signs as referenced earlier, however an extended list of behavioral changes includes the forgetting of previously learned behaviors (such as house training) and alterations in the manner in which the pet interacts with people and other pets. In addition, senior pets with CDS experience the onset of new fears and anxiety, decreased recognition of family members, places or pets, a decreased response to stimuli, a decrease in hygiene and grooming, altered appetite and decreased activity levels. (Landsberg & Araujo, 2005) Apart from the clinical signs mentioned, and importantly,

CDS may also cause emotional distress and thus, contribute to heightened levels of anxiety. Senior pets experiencing such a compromised and debilitated state may become more anxious, defensive, or even aggressive. (Landsberg et al., 2011) Heightened anxiety is one of the principle underlying factors contributing to behavioral problems in dogs. The impact this has had on the human animal bond is significant. Many of the behavioral changes and medical conditions which are associated with aging may also impair the welfare of the animal. As such, it is vitally important that owners understand and are responsive and sensitive to their pet's subtle changes in behavior as indicators of pain, welfare and quality of life. Interactions that support the human animal bond are critical to supporting the emotional needs of their aging pets. (Landsberg, DePorter, & Araujo, 2011) Many medical problems, such as other forms of brain pathologic conditions, can contribute to the clinical signs of impairment, thus it is important for the practitioner to determine the cause of the behavioral signs, eliminating, diagnosing and treating any underlying medical condition or other cause for behavioral signs before a diagnosis of CDS may be reached. (Landsberg & Araujo, 2005)

The prevalence of CDS in aging dogs has been the subject of recent studies, such as one on age related behavioral changes associated with cognitive impairment in dogs by Neilson et al. (2001). The study was conducted on a randomly selected population of dogs and compiled data on possible impairment in four behavioral categories. According to the study, in 1996, 14% (7.3 million) of all dogs in the United States were 11 years or older; the longer life span of dogs bringing with it age related degenerative changes in a number of organ systems, including those of the cardiovascular, musculoskeletal, visual, auditory, renal and endocrine systems. (Neilson et al. 2001) In the study, hospital records of dogs had been screened to exclude dogs with

dysfunction in organ systems that may cause behavioral changes. Dogs with behavioral impairment were defined as those with greater than two signs of dysfunction within a category. Categories included orientation in the home or yard, social interaction, house training and sleep wake cycle, all established areas of behavioral changes reflecting cognitive decline in aging pets. The data from the study pooled castrated males and spayed females across ages, and found the prevalence of age related progressive impairment was significant in all categories, with the following percentages noted: 28% of owners of 11-12 year old dogs reported impairment in more than one category; 68% of owners of 15-16 year old dogs reported impairment in more than one category. Data was obtained on 180 dogs in structured telephone interviews with owners, with further confirmation of the progression of age related cognitive impairment resulting from a longitudinal study on a subset of dogs in the original study. The results of the longitudinal study indicated that almost all dogs that initially had impairment in a category not only continued to have impairment in that category, but also progressed to a more severe degree of impairment due to the development of impairment in an additional category during a subsequent 16-18 month period. (Neilson et al., 2001) These findings serve to inform us of the importance of medical intervention, and screening for any underlying medical causes during early onset of symptoms in one behavioral category in order to stem the progression of cognitive decline, and thus, behavioral changes associated with it which may impact the bond between dog and owner. It was noted by the authors of the study that age related behavioral changes associated with cognitive dysfunction may be very useful indicators for medical intervention for dogs with signs of cognitive impairment. Treatment recommendations were commensurate with the findings and will be discussed in a later section.

A second study of note regarding the prevalence and predictability of behavioral changes associated with age related cognitive impairment was conducted by Bain, Hart, Cliff and Ruehl (2001), whereby owners of randomly selected dogs were interviewed by telephone twice over a 12 to 18 month interval, with a focus on similar behavioral categories as the Neilson study. The results of this study demonstrated that age related behavioral changes are progressive, in that dogs with one sign of dysfunction in a category such as orientation were found to be significantly more likely to develop impairment in that category when compared with dogs that had no dysfunction in orientation. (Bain et al., 2001) Most significantly, the study concluded in its findings that an increase in the prevalence of dogs with impairment in each category was apparent in the time span of six to eighteen months; whereas, the increase in perceived prevalence of the signs of dysfunction may partially reflect increased sensitivity of the owners to behavioral changes. No intervening contact had been made with the owners between interviews and they did not know they would be contacted for a second interview, however, they did receive an information sheet advising them of the types of age related behavioral changes they might expect to see. This underscores that fact that with minimal education and observation, clinical signs of cognitive decline were noticeable, making intervention with the neuroprotective seligiline more likely to occur. In a clinical setting, the results of this study may be useful in predicting which dogs are most likely to progress to a severe degree of impairment. (Bain et al., 2001) Thus, in terms of medical or behavioral intervention in aging dogs, the findings from the study suggest that dogs with one sign of dysfunction in orientation, social interactions or house soiling would be candidates for early treatment with the neuroprotective and dopaminergic drug seligiline.

Pathophysiology

Behaviors such as disorientation, loss of house training and impaired recognition of family members do reflect impairment of memory and learning, though they are not necessarily manifestations of impairment in cognitive behavior, and so would logically be linked with impairment of cognitive function. (Neilson, et al., 2001) The use of terms such as cognitive dysfunction are predicated on the assumption that these changes reflect neuronal, neurotransmitter, metabolic, cerebrovascular, or biochemical degenerative changes in the brain, and are not a reflection of dysfunction in other organ systems. It has been known for some time that aged dogs accumulate B-amyloid deposits in the hippocampus and frontal cortex (Neilson et al., 2001), which are areas especially involved in changes in cognitive behavior. Recent research indicates that the deposits are similar in nature to those found in early stage B amyloid plaques in the brains of human Alzheimer's patients. (Neilson et al., 2001) In humans, the plaques mature into discrete plaques that result in neuronal death. Further, results in research on aging beagles found that the degree of amyloid deposits correlates to degree of impairment in learning complex tasks. Further evidence of pathophysiology of CDS in dogs is supported by the approval of seligiline for treatment of the disease. Seligiline is a selective inhibitor of monoamine oxidase B. The exact mechanism by which it has a positive effect on dogs is unknown, however, it is posited that at least the following effects play a role: an increase in dopamine activity in the cortex and hippocampus, a decrease in free radical load in the brain and a neuroprotective effect on noradrenergic, dopaminergic and cholinergic neurons. According to Cotman, Head, Muggenburg, Zicker and Milgram, (2002), the brain progressively accumulates oxidative damage along with neuropathology that ultimately results in neuronal dysfunction and cognitive

decline. Cotman et al. (2002) found that the generation of oxidants that progressively increase over time leads to damage to proteins, lipids and nucleotides, which may contribute significantly to neuron dysfunction and degeneration associated with neurodegenerative disease and aging. With increasing age, there is a reduction in brain mass, including cerebral and basal ganglia atrophy, an increase in ventricular size, meningeal calcification, demyelination and glial changes; neuro-axonal degeneration; and a reduction in neurons. (Landsberg & Araujo, 2005) In addition, a number of vascular and perivascular changes have been identified in older dogs. Functional changes that occur in the aging brain include depletion of catecholamine, neurotransmitters, and increase in monoamine oxidase B (MOAB) activity and a decline in cholinergic integrity. Cholinergic decline is established in aging and Alzheimers disease, and it may play a significant role in the early spatial memory decline in dogs. (Landsberg & Araujo, 2005) The exact role of amyloid B plaque accumulation in the development of cognitive dysfunction is yet to be determined, however; it is neurotoxic and can lead to compromised neuronal function, degeneration of synapses, cell loss, and depletion of neurotransmitters. In addition, amyloid B plaque accumulation is positively correlated with the severity of cognitive dysfunction. (Cotman et al., 2002) In dogs, errors in learning tests were strongly associated with increased amounts of B-amyloid deposition, though a causative role has not been established. (Head, Callahan, Muggenburg et al.,1998; in Landsberg & Araujo, 2005)

Behavioral Changes and Welfare

That the aging process is associated with progressive and irreversible changes that could affect a pet's behavior has indeed been widely reviewed and confirmed in the literature, covering

both medical and cognitive causes of behavior problems in the aging pet. Behavioral signs are often the first and sometimes only sign of pain, illness and cognitive decline. As previously noted, apart from the clinical signs mentioned, CDS may also cause other symptoms such as anxiety, which is one of the main underlying factors contributing to behavioral problems in dogs. In addition, senior pets often present with multiple medical conditions, resulting in increased behavioral problems. (Landsberg & Araujo, 2005). The combined factors may push a pet beyond a threshold to where a new behavior problem is exhibited, including the development of a lower “threshold” or level of tolerance at which a senior pet might respond to stimuli. A senior dog that is fearful of children may begin to bite as it becomes more uncomfortable, less mobile, or develops visual or auditory decline. (Landsberg & Araujo, 2005) In addition, changes in the pet’s immediate environment such as schedule changes, the introduction of a new member of the household, a new pet, or even environmental modifications brought about by home renovations may all influence a pet’s behavior. Medical or degenerative changes also make a pet less adaptable to change. One of the primary problems in this scenario is that owners may inadvertently reward problem behaviors as they emerge (Landsberg & Araujo, 2005); absent the necessary information on their pet’s aging process as to what behaviors they might expect to develop, preventative health care measures that can be taken and how to respond effectively to behavior changes. Moreover, lack of education may result in a decline in the welfare of their aging pet, as many of the behavioral changes and medical conditions which are associated with aging may impair the welfare of the animal as defined by the Five Freedoms. (Manteca, 2011) Animal welfare is defined as being impaired when any of the Five Freedoms are compromised. Many of these diseases result in pain or interfere with expression of normal behavior. In

particular, the most significant effect of CDS on welfare is that it causes an increase in anxiety and stress in senior dogs. As owner frustration with problem behavior increases, owners may inadvertently add to their aging pet's anxiety, especially if punishment is used to deter the behavior. (Landsberg & Araujo, 2005) To the extent that this can be prevented or detected early through advocating by professionals and well informed pet owners, the welfare of the geriatric patient may be greatly improved and the human animal bond preserved.

According to Landsberg & Araujo, (2005) since older pets have a declining immune system, they are at higher risk for neoplasia and degenerative diseases, including many conditions that can be very painful, such as arthritis. Pain and sensory impairment have a profound effect on behavior and often go unreported, with owners in one canine study reporting signs attributed to visual and auditory impairment, at 41% and 68% respectively for 11-12 year olds and 15-16 year olds. These behavioral signs could be caused by either impairment of the sensory organ itself, or cognitive dysfunction, since behavior and memory circuits are located in the forebrain, such as in the limbic system and the hippocampus. In addition, behavioral changes could arise from any disease process that involves the brain stem, or from deficits in the sensory system that provides input to these areas. Therefore, should any behavioral problems arise, a full physical examination, neurological assessment as well as screening and diagnostic testing is required initially. (Landsberg & Araujo, 2005)

In a study to evaluate behavior of dogs of various ages as viewed by owners in households in the Czech Republic, it was demonstrated that the group of older dogs of greater than eight years in the study (12 dogs) were frequently described by owners as nervous and

sometimes difficult to control, excessively barking, whining and howling. (Baranyiova, Holub, Janackova and Ernstova, 2004) On the other hand, they were also described as protective of the household, household members, and were most often walked unleashed, as compared with the group of animals younger than one year (35 dogs), and the group of middle aged dogs (220 dogs) which were described as destructive in the house and dominant, respectively. These differences were cited as further confirmation of earlier findings on the ontogeny of dog behavior, showing some changes in the coexistence of people and dogs of various ages in Czech households. Most importantly, it was noted that they served as basic information about behavior problems that may be encountered in veterinary practice, and demonstrate a need for client education programs and preventive behavioral medicine in the Czech Republic. (Baranyiova et al., 2004) Changes associated with aging do not always reflect an underlying pathology, making it difficult to establish baselines for normality in behavior. Therefore, it is useful to identify normative behaviors associated with successful aging in dogs, in order to better educate owners and to assist in the identification of problems related to CDS early on in the aging process. To this end, Salvin, McGeevy, Sachdev and Valenzuela (2011) released a study designed to develop baseline values for normative behavior changes in successfully aging dogs, and the rate of deterioration that can be expected over a six month period. The results of this study demonstrated that the modal frequency of problem behaviors such as locomotory and abnormal ingestive items was low, and effect on learning and memory minimal. In spite of this finding, more than half the twenty one items tested were reported to have shown greater than 10% incidence of deterioration, particularly activity and play levels, responses to commands and fears and phobias, which showed considerable deterioration. Thus, the first steps towards developing a baseline for

normal behavioral changes has been established for “successfully aging” dogs. (Salvin et al., 2011)

Management and Treatment

Management of CDS in senior dogs includes dietary and pharmacological intervention. In addition, changes in the dog’s environment may be extremely helpful. (Manteca, 2011) Dietary treatment of CDS in dogs has been based on the use of antioxidants and mitochondrial cofactors that may decrease the deleterious effects of free radicals. According to Manteca, (2011) there is ample evidence today suggesting that free radicals play a significant role in aging, with the brain being particularly susceptible to the effects of free radicals due to its high content of lipids , high rate of oxidative metabolism and a limited ability for regeneration. (Cotman et al., 2002, in Manteca, 2011) In the study by Cotman et al., (2002) it was shown that antioxidants improve the performance of aged rodents, and there are also several studies showing that an antioxidant enriched diet improves cognitive performance in senior dogs. (Ikeda-Douglas, Zicker, Estrada, et al., 2004; in Manteca, 2011) Recent research has provided evidence that when aged beagle dogs were given a diet supplemented with medium-chain triglycerides (MCT), that group showed significantly better performance on most of the test protocols than did the control group of aged beagles. In particular, the group differences varied with respect to task difficulty levels, with the more difficult tasks showing greater supplementation effects than some of the easier tasks. The dogs in the treatment group showed elevated levels of beta hydroxybutrate; thus, it is suggested that supplementation with MCT improves cognitive function in aged dogs by providing the brain with an alternative source of energy. (Pan, Larson, Araujo, et al., 2010; in Manteca, 2011)

Repeated reference to the risks of increased anxiety or stress developing in aging dogs makes clear the need to address the growing prevalence of CDS from the standpoint of behavioral changes resulting from anxiety and duress. Nutraceuticals can be useful in treating and reducing anxiety, although the use of these supplements must be combined with behavior modification techniques. (Manteca, 2011) Alpha-casozepine, a biopetide derived from milk reduces anxiety in laboratory rodents, and preliminary results show the same effects in dogs. (Beata, Lefranc and Desor, 2005; in Manteca, 2011) Alpha-casozepine is now available for use in companion animals in some countries in Europe, however it is recommended that its use be combined with behavior modification techniques. Nutritional management in the treatment of behavior problems like aggression, which result from insufficient levels of the brain neurotransmitter serotonin in aging dogs with CDS, includes a low protein diet supplemented with tryptophan, as serotonin is synthesized in the CNS from tryptophan. There is ample evidence, according to Manteca (2011), that serotonin activity in the central nervous system is negatively correlated with aggression, and that increasing serotonin activity reduces aggression in many species, including the domestic dog. (Reisner, Mann, Stanley, et al., 1996; Edwards& Kravitz, 1997; in Manteca, 2011) It is noted that from a behavioral standpoint, senior dogs are more susceptible to stress, particularly when they are exposed to novelty within their environment. Manteca points out that the feeding behavior of animals is important; not just to satisfy nutritional needs, but the more important, so called, “ behavioral needs”. (Manteca, 2011) Although the mechanisms which underlie the effects of stress on feed intake are not completely understood, it is known that the corticotropine-releasing hormone (CRH) plays a key role in the stress response, and appears to have a

significant effect on appetite. Thus, the ability to express normal behavior patterns such as food intake has positive effects on health and welfare.

Environmental enrichment is widely used with both captive wild animals and domesticated animals to improve their welfare. Environmental enrichment techniques follow several guiding principles, which have been established for animals in captivity: a) increasing control between animal action and environmental reaction, b) presenting cognitive challenges such as learning something a trainer might request, or solving a problem, c) meeting specific behavioral needs such as foraging or need for shelter, d) providing an environment where exploration is stimulated and rewarded, and e) stimulating social interaction. (Manteca, 2011) In aged dogs, there is ample evidence environmental enrichment has positive effects on cognitive performance, and thus should be part of the educated owner's tool box in mitigating their pet's discomfort, as it reduces stress in most cases. These effects are more pronounced when dietary treatment is combined with environmental enrichment activities. (Manteca, 2011)

Pharmacologic treatment options for CDS in dogs includes Seligiline, a selective and irreversible inhibitor of monoamine oxidase B, (MOAB) in the dog, and is the first therapeutic agent approved for the treatment of CDS in dogs. Seligiline increases dopamine activity in the cortex and hippocampus, decreases free radical load in the brain by directly scavenging free radicals, and has a neuroprotective effect on dopaminergic, cholinergic and noradrenergic neurons. (Manteca, 2011; Landsberg, 2005) Catecholamine enhancement may lead to improved neuronal impulse transmission. Once treatment has been started, the senior dog will need to stay on this medication permanently. Seligiline reverses the effects of aging in the brain, and can have

the effect of enhancing the aging dog's cognitive function, (Landsberg, 2005) and therefore activity levels, interest in people and social interaction; preserving the bond between owner and pet, and improving the quality of life of the beloved, aging dog. Drugs that may enhance the noradrenergic system such as adrafinil and modafinil might also be useful in older dogs to improve alertness and help maintain sleep wake cycles. Drugs that improve cerebral vascular circulation also have the potential to improve the signs of cognitive decline. (Landsberg, 2005)

Dietary therapy now includes a new canine therapeutic diet, Canine b/d, offered by Hills Pet Nutrition. It's efficacy in the treatment of CDS in dogs has been tested over a period of two years in clinical trials, as well as neuropsychological testing procedures. The formula includes mitochondrial cofactors, as referenced earlier, with the goal of improving antioxidant defenses. Complimentary therapies offer a wide variety of choices in the prevention and treatment of CDS in aging dogs, including nutraceuticals, herbal extracts and vitamins to help calm, reduce anxiety and induce sleep. These include melatonin, valerian root, Bach's flower remedies, and DAP, a synthetic pheromone modeled upon those secreted from a lactating bitch. (Landsberg, 2005) Some of the complimentary products have purported to be useful in improving or even in preventing cognitive decline, with many now incorporated into supplements for senior pets. Although some reports have indicated improvement in cognitive function with these products, to date there has not yet been any published data from either cognitive studies or clinical trials to validate their efficacy. (Landsberg, 2005)

Other treatment considerations might include antidepressants and anxiolytics such as benzodiazepines, since alterations in neurotransmitters or their receptor sites can lead to

behavioral changes like irritability, decreased responsiveness to stimuli, fear, agitation, altered sleep awake cycles, and depression. (Landsberg, 2005)

CDS: a Welfare Issue

Animal behavior problems often have negative effects on the relationship between pet and owner, functioning as important factors in relinquishment decisions by owners. In a study about behavioral relinquishments of pets to shelters, Salmon, Hutchinson, and Ruch-Gallie, (2000) as part of a national research project, found that behavioral reasons topped the list for relinquishment. In the behavioral reasons given for the relinquishments, more than half the reasons are represented in dogs with CDS. In particular, it was found that dogs relinquished for behavioral reasons appear to be older in age. It was also determined that these older dogs likely had more opportunity to be trained, yet still exhibited behavior problems. (Salman, et al. 2000) Owners of dogs exhibiting signs of cognitive impairment may find it increasingly difficult to cope with the changes in behavior of their pet. In this regard, and as evidenced in the statistics regarding relinquishment, the human animal bond can be weakened or even broken by a pet with behavior problems such as those referenced herein, and are represented in a large percentage of the senior pet population. With the short life span of their pets, owners will have to make difficult decisions based on the quality of life of their senior pet. (Landsberg, 2005) Many of the behavioral changes and medical conditions of aging pets may impair the welfare of the animal, as defined by the five freedoms. Several diseases may result in pain or interfere with the expression of normal behavior. A primary effect on the welfare of aging dogs resulting from cognitive decline, as previously noted, is that it causes an increase in anxiety or stress, especially

when animals are exposed to novelty. (Manteca, 2011) When threatened by aversive stimuli, (and often it is a perception of aversive results from a stimuli,) senior pets with CDS are at a distinct disadvantage in their organization of responses to this aversive or threatening stimuli, due to a decline in cognitive function. It is therefore important first and foremost to provide senior animals exhibiting signs of CDS with an environment that does not lead to unnecessary stress. Avoiding sudden changes in the animals' routine and allowing it to have control over its environment seem particularly important. (Manteca, 2011) Secondly, the ability to express normal behavior patterns has positive effects on the health and welfare of animals. The use of environmental enrichment techniques by owners can make the difference in their animal's ability to interact with them and within its environment successfully and with comfort. A number of therapeutic agents are now licensed for the treatment of cognitive dysfunction in dogs. Considering the possible neuroprotective and antioxidant effects afforded by many of these products, they might prove to be an even more useful means of slowing progression of the disease than simply a symptomatic treatment. (Landsberg, 2005)

Discussion

It would seem prudent as a professional to advise pet owners to begin treatment with these drugs and supplements at the earliest possible signs of cognitive impairment. Pet owners should be encouraged to work closely with their veterinarians to report any behavioral changes as soon as they manifest. Consideration should also be given to beginning treatment for senior dogs even before the onset of clinical signs, since laboratory tests are not yet available to pet owners that can detect learning and memory impairment. Early detection allows for early

intervention, as is the case with disease of the human body. In addition to cognitive dysfunction, the behavioral changes it is associated with may be the first sign of a wide range of disease processes that may be painful such as arthritis or dental disease. (Landsberg, 2005) Addressing these signs early in their manifestation can prevent an unnecessary decline in the life and welfare of the animal who may suffer from CDS.

Increased life span in dogs brings with it new medical challenges for veterinarians and caregivers. We know that treatment with an approved pharmacologic agent called seligiline can arrest and reverse the process of aging, altering the effects of cognitive decline when animals are treated early. We have heard that intervention with pharmacologic treatment, environmental enrichment and dietary supplements, including complementary therapies, have shown efficacy and are available in the prevention and treatment of CDS. We have heard that veterinarians caring for older dogs will need to integrate behavioral counseling for these special patients. (Frank, 2003, Baranyiova et al., 2004) Having established the normative baseline values for anticipated behavioral changes and behavioral dysfunction as dogs age, it seems that by making sure information on “successful aging” and what to expect as your dog ages (including information on the clinical behavioral signs of cognitive decline) gets into the hands of owners early on in the lives of their pets, we have the potential to reverse a growing trend of cognitive decline and therefore reduce pet relinquishments due to behavior problems associated with CDS. It is clear from the research that utilizing available prevention and treatment options can make the difference as to whether dogs will thrive at home as they age, or whether the bonds between owner and dog will deteriorate, resulting in loss of connection and love for both.

References

- Bain, M.J., Hart, B.J., Cliff, K.D., Ruehl, W.W., 2001. Predicting behavioral changes associated with age-related cognitive impairment in dogs. *Journal of the American Veterinary Medical Association*; 218, 1792-1795.
- Baranyiova, E., Holub, A., Tyrlik, M., Janackova, B., Ernstova, M., 2004. Behavioural differences of dogs of various ages in Czech households. *Acta. Vet. Brun.* 73, 229-233.
- Beata, C., Lefranc, C., Desor, D., (2005) Lactium; a new anxiolytic product from milk, in Mills, D. Levine, E., Landsberg, G. (eds): *Current Issues and Research in Veterinary Behavioral Medicine*. West Lafayette, IN, Purdue University Press
- Cotman, C.W., Head, E., Muggenburg, B.A., Zicker, S., Milgram, N.W. (2002) Brain aging in the canine: a diet enriched in antioxidants reduces cognitive dysfunction; *Neurobiology of Aging*, Volume 23, Issue 5, September-October 2002, Pages 809-818
- Edwards, D.H. & Kravitz, E.A., (1997) Serotonin, social status and aggression. *Current Opinion, Neurobiology* 7:812-819
- Frank, D. (2003) Cognitive Dysfunction in dogs; In: Proceedings of the Hill's European Symposium on Canine Brain Aging, 2002

- Landsberg,G.M. DePorter,T., Araujo,J.A. (2011) Clinical Signs and Management of Anxiety, Sleeplessness, and Cognitive Dysfunction in the Senior Pet; *Veterinary Clinics of North America: Small Animal Practice, Volume 41, Issue 3, May 2011, Pages 565-590*
- Landsberg,G., Araujo, J.A. (2005) Behavior Problems in Geriatric Pets; *Veterinary Clinics of North America: Small Animal Practice, Volume 35, Issue 3, May 2005, Pages 675-698*
- Landsberg, G.M., (2005) Therapeutic agents for the treatment of cognitive dysfunction syndrome in senior dogs; *Progress in Neuro-Psychopharmacology & Biological Psychiatry 29* (2005) 471– 479
- Manteca, X. (2011) Nutrition and Behavior in Senior Dogs; *Topics in Companion Animal Medicine, Volume 26, Issue 1, February 2011, Pages 33-36*
- Neilson,J.C., Hart,B.L., Cliff, K.D., Ruehl, W.W. (2001) Prevalence of behavioral changes associated with age-related cognitive impairment in dogs; *Journal of the American Veterinary Medical Association, June 1, 2001, Vol. 218, No. 11, Pages 1787-1791*
- Reisner, I.R., Mann, J.J., Stanley, et al., (1996) Comparison of cerebrospinal fluid monoamine metabolite levels in dominant aggressive and non aggressive dogs. *Brain Research 14*: 57-64
- Salman, M.D., Hutchinson, J., Ruch-Gallie, R., Kogan, L., New, J.C., Kass, P.H., Scarlett, J.M., 2000. Behavioural reasons for relinquishment of dogs and cats to 12 shelters. *Journal of Applied Animal Welfare Science*; 3, 93-106.
- Salvin, (2011) Growing old gracefully—Behavioral changes associated with “successful aging” in the dog, *Canis familiaris*; *Journal of Veterinary Behavior: Clinical Applications and Research Volume 6, Issue 6 , Pages 313-320, November 20*

