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# Cognitive Dysfunction in Dogs

## DEFINITIONS

Cognition, broadly defined, refers to mental processes such as perception, awareness, learning, memory, and decision making. Cognition allows an animal to take in information about the environment, process, retain, and make decisions on how to act<sup>41</sup>. These mental processes cannot be measured directly. Over the last 10 years several publications on canine cognition have appeared<sup>2, 21, 29, 30</sup>. Different cognitive tasks have been developed to evaluate learning and memory in dogs. These tasks are conducted in a laboratory setting and are not readily applicable in general veterinary practice.

## Canine cognitive dysfunction

The term canine cognitive dysfunction was introduced to describe geriatric behavioural changes not solely attributable to a general medical condition<sup>34, 36</sup> such as infection, organ failure or neoplasm. These behavioural changes fall mostly into four categories namely loss of cognition and recognition, loss of housetraining, disorientation, and changes in the sleep-wake cycle. Old dogs do not all exhibit signs of cognitive dysfunction. Other terms such as senile dementia<sup>3</sup> and senile degeneration of the brain<sup>25</sup> were also used in the literature. Dementia is clinically manifested as behavioural changes, loss of attentiveness and/or loss of housetraining. Dementia can result from



**Figure 1. Twelve year-old normal malamute.** *Older dogs become less active and may sleep more soundly, even without cognitive dysfunction.*

encephalitis, tumours, or other structural diseases, metabolic conditions (hypothyroidism) or can be unexplained. It was stated that senile dementia should never be considered a normal ageing change but rather a pathologic condition.<sup>13</sup>



**Figure 2.** 17 year-old West Highland white terrier. Old animals are often affected by more than one disorder concurrently. This dog was treated with selegiline for cognitive dysfunction and also received chemotherapy for lymphosarcoma (note the sparse haircoat).

### Human dementia

In human medicine, a diagnosis of dementia will be considered if cognitive deficits exceed that which would be expected given a person's age and if they are severe enough to compromise a person's social and/or occupational functioning. An essential criterion for dementia is memory impairment and at least one of the following cognitive disturbances: aphasia (deterioration of language function), apraxia (inability to carry out purposeful movement), agnosia (failure to recognise—especially people), disturbed executive functioning (ability to plan, organise, pay attention). Cognition in humans can be assessed through the use of a variety of objective and subjective tests done in a clinical setting. Alzheimer's disease is the most common cause of dementia.

### CLINICAL PRESENTATION OF CANINE COGNITIVE DYSFUNCTION

Signs can be divided into four categories, namely 1) loss of recognition and cognition, 2) loss of housetraining, 3) disorientation, and 4) nocturnal activity (changes in the sleep-wake cycle). Interactions of the dog with family members become less frequent and/or less intense. Some dogs may actually not recognise a family member. House-training was previously correctly acquired but now seems "forgotten" by these patients.



**Figure 3.** 17 year-old West Highland white terrier with cognitive dysfunction. The dog was urinating in inappropriate locations and had to wear Pampers all the time (A). One day he became stuck in a corner of a bedroom (B) and couldn't find a way out without the owner's help.

Urination is perhaps a more common complaint than defecation. The behavioural sequence is characteristic of normal elimination and occurs in the absence of environmental changes (such as lack of access to an appropriate area) or medical problems (FIGURE 3A). The dog will eliminate regardless of owner presence or absence. Soiling occurs in various locations. Some of these dogs are reported to get lost in the house or yard. They stare into space, get stuck in a corner (FIGURE 3), go to the wrong door or to the wrong side of the door, and seem to wander without purpose. Other dogs are reported to sleep more during the day but are up at night. They may whine, vocalise, wander, pace, or scratch the ground and will eventually wake up the owners.

Clinical signs that may also be reported include excessive barking and/or vocalisation, intolerance to exercise, difficulty navigating up a flight of stairs, increased irritability, new fears and phobia and

destruction during owner absence. Some dogs become more “clingy” and follow the client’s every move.

One retrospective study<sup>7</sup> reviewing behavioural problems of old dogs seen in a referral service from 1984-1987 listed the most frequent owner complaints as destructive behaviour, urinating and/or defecating in the house, and excessive vocalisation. Behavioural problems in these old dogs were usually not the continuation or the exacerbation of problems acquired earlier in life but rather newly acquired behaviours. Most of these dogs had primary behaviour problems without any other associated disease. The two most common diagnoses at the time were separation anxiety and breakdown of housetraining. Canine cognitive dysfunction was not yet recognised. “Old age onset separation anxiety” and “breakdown in housetraining” may in fact have been non-specific signs of canine cognitive dysfunction. In France one author<sup>35</sup> describes three conditions seen in older dogs: “le syndrome confusionnel du vieux chien”, “la dépression d’involution”, and “la dysthymie du vieux chien”. “Le syndrome confusionnel du vieux chien” corresponds to normal ageing of the dog, and “la dépression d’involution” has many common clinical features<sup>6</sup> with canine cognitive dysfunction.

### DIFFERENTIAL DIAGNOSIS

Veterinarians have always recognised that older dogs seemed less mentally alert and responsive, slept more, and seemed forgetful in familiar environments. An old dog presenting with non-specific signs compatible with cognitive impairment requires a complete physical examination, neurological evaluation, complete blood cell count, biochemistry profile and urinalysis. Clinical signs that can be associated with cerebral neoplasms include non-specific behaviour or mentation changes, aggressive behaviour, abnormal sleep patterns, change in eating habits, changes in house training, wandering and so forth<sup>13</sup>. Seizures will occur in only 45% of dogs with brain tumours<sup>3</sup>, so absence of seizures does not exclude the possibility of cerebral neoplasms. Imaging studies such as CT scan or MRI rule out neoplastic causes of

cognitive impairment. Decreased sight and hearing are common findings in the old dog and age-related hearing loss can certainly account for sleeping more soundly, apparent inattention and inability to localise the source of a sound<sup>26</sup>. Metabolically the ageing dog shows decline. Endocrine disorders can affect mentation so endocrinopathies such as hypothyroidism and hyperadrenocorticism should also be ruled out.

### DIAGNOSIS OF CANINE COGNITIVE DYSFUNCTION

In the clinical setting, a diagnosis of canine cognitive dysfunction is tentatively obtained when all other causes of cognitive impairment have been ruled out. Diagnosis can be confirmed at necropsy. It should be noted that diagnosing a medical condition does not exclude the possibility of concurrent unrelated cognitive dysfunction.

### EPIDEMIOLOGY

Data were obtained on behavioural changes in old dogs<sup>17,33</sup>. The most recent retrospective study looked at 180 dogs (83 castrated males and 97 spayed females) representing 3 age groups, namely, dogs aged 11-12 (n=80), 13-14 (n=66), and 15-16 year-old (n=34). The purpose was to assess behaviour in the four following categories: 1) orientation in the home and yard, 2) social interactions with human family members, 3) house-training, and 4) the sleep-wake cycle. Impairment was defined as 2 or more signs within a category. For example, signs of impairment in orientation could include staring into space, getting lost in the house or yard, getting stuck in corners, standing at the wrong door or on the wrong side, etc. Mild cognitive impairment was defined as signs in only one category whereas severe cognitive impairment was described as signs in 2 or more categories. The percentage of 11 to 12 year-old dogs with minor impairment was 17.5% and severe impairment was 10% (total number of dogs affected 27.5%). The percentage of 15 to 16 year-old dogs were 32% and 35% for mild and severe impairment respectively (total number of dogs affected 67%). Data were also collected to monitor progression of age-related behavioural

changes in old dogs over a period of 6-18 months<sup>4</sup>. The increase in impairment was significant within all categories between the two interviews. Impairment in one category was significantly predictive of impairment in 2 or more categories 6-18 months later.

## NEUROPATHOLOGY

Publications have indicated that there may be similarities between canine cognitive dysfunction and Alzheimer's disease<sup>8, 11, 38</sup>. Aged dogs do not develop Alzheimer's disease because they lack neurofibrillary tangles, one of the classic markers of the neuropathology. But there are similarities such as accumulation of  $\beta$ -amyloid protein in the form of senile plaques in similar cortical areas of the brain. Cognitive decline in aged dogs is strongly associated with the accumulation of  $\beta$ -amyloid<sup>9</sup>. One author cautions that the pathology is relatively non-specific in both conditions<sup>34</sup>. Additional data on the underlying biology must be elucidated in order to validate or reject the canine model for human geriatric dementia. Interest on the neuropathology of ageing and cognitive impairment is certainly high<sup>5, 14, 23, 47</sup>. And several authors believe that the dog is a good model of human cognitive ageing<sup>1, 18, 19, 42, 44, 46</sup>.

## TREATMENT FOR CANINE COGNITIVE DYSFUNCTION

Following appropriate medical evaluation and diagnosis of canine cognitive dysfunction, pharmacological treatment can be initiated. Selegiline is the only drug currently available and labelled for canine cognitive dysfunction in Canada and the United States. Selegiline (Anipryl<sup>®</sup>, Selgian<sup>ND</sup>) is given at a dose of 0.5-1 mg/kg orally once daily in the morning<sup>36</sup>. Many owners typically



**Figure 4. 13 year-old whippet with cognitive dysfunction.**  
This dog had stopped greeting her owner at the door. The greeting behaviour reappeared within two weeks of treatment with selegiline.

report improvement within the first two weeks of treatment (FIGURE 4).

In one study following one month of treatment approximately 77% of dogs improved, but a few demonstrated improvement only in the second month of therapy. Selegiline is being studied to assess effects on behaviour and learning in aged dogs<sup>20, 22, 31, 38</sup> and young dog less than 7 years old<sup>32</sup>. Selegiline given at a dose of 1 mg/kg to relatively healthy dogs 10-15 years of age was reported to prolong life<sup>37</sup>. Other drugs (propentophylline, nicergoline, adrafinil) are also being evaluated in aged dogs<sup>28, 43</sup>.

Pharmacological treatment for Alzheimer's disease currently relies mostly on cholinesterase inhibitors<sup>12, 15</sup>. Unfortunately improvement is moderate and short-lived. Other compounds that reduce neuronal damage and limit oxidation are being studied in clinical trials. These include monoamine oxidase (MAO-B) inhibitors, anti-inflammatory agents (NSAIDs), antioxidants (vitamin E), oestrogen, and others.

Researchers have looked at the effect of gonadectomy on subsequent development of age-related cognitive impairment in dogs<sup>16</sup>, sex differences in the effect of oestrogen on learning and memory of dogs<sup>45</sup>, and dietary intervention for age dependent cognitive dysfunction in canines<sup>27</sup>. Other recommendations for canine cognitive dysfunction have included installing ramps or padded steps, giving the dog more frequent access to appropriate elimination areas, or using diapers. Some authors have suggested teaching or re-training an old dog to eliminate in an appropriate location. However teaching new simple tasks to a cognitively impaired dog is sometimes difficult... These dogs are unable to acquire and retain the new lessons.

## CONCLUSION

Dogs that are receiving improved medical care, nutrition and veterinary medical guidance are living longer and longer. And cognitive dysfunction is likely to increase along with the dog's age. Increased life span brings along new medical challenges for veterinarians and caregivers. Veterinarians caring for older dogs will need to integrate behavioural counselling for these special patients.

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