



# Cognitive Dysfunction Syndrome in Dogs

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## Introduction

As a result of the advances in nutrition and veterinary medicine of recent years, the life expectancy of dogs has increased considerably. This phenomenon goes hand in hand with an increase in the incidence of frequent pathologies during the aging process, including neurodegenerative diseases such as Cognitive Dysfunction Syndrome (CDS).

The CDS is a set of symptoms that are associated with the gradual and progressive loss of cognitive capacity in old dogs. It is associated with well-defined pathological changes similar to those experienced by people suffering from Alzheimer's disease. The CDS can manifest itself through behavioral changes, decreased learning ability and memory, decreased response to stimuli and confusion. This pathology can severely affect the quality of life of the animal and human animal bond.







The clinical signs that accompany CDS include deficits in one or more of the following categories. These categories are represented by the acronym DISHAA: disorientation, altered social

interactions, changes in the sleep-wake cycle, loss of learned behaviors, alteration of activity levels, and increased level of anxiety (Table 1). Some dogs may present a single clinical symptom belonging to a single category, while others may exhibit several symptoms in a variety of categories.

## Prevalence

The prevalence of this problem varies according to the different studies and is between 14% and 60% in dogs from 8 years of age. Both the prevalence and severity of symptoms increase with age. Thus, for example, a study where the behavior of dogs between 11 and 16 years of age was evaluated, showed that in dogs between 11 and 12 years old, 28% had at least one category of DISHAA affected while 10% of them had two or more categories affected. On the other hand, in dogs between 15 and 16 years old, 68% had at least one category of DISHAA affected, while 36% were positive for at least two categories.

Table 1. Frequent clinical signs in SDC (modified from Landsberg et al., 2017)

Acronym	Categories	Frequent clinical signs
	DISORIENTATION	<ul style="list-style-type: none"> <li>• The dog gets stuck in a corner.</li> <li>• Stays looking at a fixed point.</li> <li>• It does not recognize familiar people or animals.</li> <li>• Less reactive to visual or auditory stimuli.</li> </ul>
	ALTERED SOCIAL INTERACTIONS	<ul style="list-style-type: none"> <li>• More irritable / fearful / aggressive with people or other dogs.</li> <li>• Decrease interest in having social contact with their owners.</li> </ul>
	CHANGES IN THE SLEEP-WAKE CYCLE	<ul style="list-style-type: none"> <li>• Walk / sleep little during the night.</li> <li>• Nightly vocalizations.</li> </ul>
	ALTERATION OF LEARNING AND MEMORY	<ul style="list-style-type: none"> <li>• Housesoiling.</li> <li>• Difficulty learning new commands or responding to previously learned commands.</li> </ul>
	ALTERATION OF ACTIVITY LEVELS	<ul style="list-style-type: none"> <li>• Decreased exploratory and play behaviors.</li> <li>• Increased activity - walks from one side to the other.</li> <li>• Repetitive behavior (eg., circling, excessive licking).</li> </ul>
	INCREASED LEVEL OF ANXIETY	<ul style="list-style-type: none"> <li>• Increased anxiety when separated from its owners.</li> <li>• More reactive / fearful when faced to visual or auditory stimuli or other novel stimuli.</li> </ul>



Despite the high prevalence of this syndrome, several studies show that most owners do not report to their veterinarian when they have a dog with symptoms compatible with CDS, unless they are actively asked. This low reporting rate could be related to owners who do not realize the subtle signs or who see them as untreatable, insignificant, or typical of aging. Owners may not notify their veterinarian until the signs have advanced so far that they have a negative impact on the owner and it is evident that the dog is suffering. This is unfortunate if one takes into account that the faster the problem is diagnosed and a treatment is started, the more likely it is to improve the symptoms, slow down the progression of the symptoms and improve the welfare of the dog.

## Diagnosis

The diagnosis of CDS is one of exclusion; that is, in order to diagnose this syndrome, in the first place, medical problems that may be the direct cause of changes in behavior or that may aggravate them must be ruled out.

The anamnesis, the general physical, neurological and traumatological examination, together with the results of the basic laboratory tests can lead to a definitive diagnosis or determine if it is necessary to perform more complex diagnostic tests (for example, radiographs, ultrasounds, MRI, etc.). Once all the possible medical problems that could cause or contribute to the behavioral changes presented by the animal have been ruled out, the diagnosis of CDS can be reached. Bearing in mind that these are old dogs, it is not uncommon for the CDS to present itself concomitantly with other medical problems, which can be a diagnostic challenge for the veterinarian. For example, an inadequate urination problem could be due to SDC and / or medical problems such as pain and any medical condition that causes polyuria (such as kidney problems or diabetes). Therefore, the clinician should keep in mind that the characteristics of behavioral signs may overlap with those of medical problems.

As mentioned above, most owners of dogs with symptoms compatible with CDS do not usually consult with the veterinarian, especially if the symptoms are mild. In order to increase the diagnostic rate, veterinarians should inform clients about the advantages of early detection and early treatment on the quality of life and well-being of patients. In this sense, the questionnaires designed to diagnose behaviors compatible with CDS are usually very useful for the proactive diagnosis of this syndrome. They can be provided to the owners before the visit or at the time of the visit.

*Early diagnosis and early implementation of treatment measures are essential to obtain a better response and improve the quality of life of the patient*

## Treatment

Although CDS is a degenerative disease that has no cure, carrying out an adequate treatment, enables the chance to slow the progression of the symptoms and significantly improve the quality of life of the patients. The sooner the treatment is implemented, the better the response, hence the importance of early diagnosis.

In addition, it is essential to resolve or control any medical problem (eg., arthritis, diabetes, cystitis) that could be worsening the symptoms. If the medical problems are not controlled, it is likely that the specific treatment is not practical.

The main objective of the treatment of this syndrome is to slow the advance of neuronal damage and cell death and alleviate the clinical symptoms. The use of diets, dietary supplements and drugs can be used to improve neurotransmission and reduce oxidative damage and inflammation.

The general objectives of the treatment are:

- ▶ Slow the progression of the disease.
- ▶ Recover cognitive abilities to a level where normal behaviors can be re-established.
- ▶ Recover behaviors that had been learned and lost.
- ▶ Improve the quality of life of the patient.

## Diets and dietary supplements

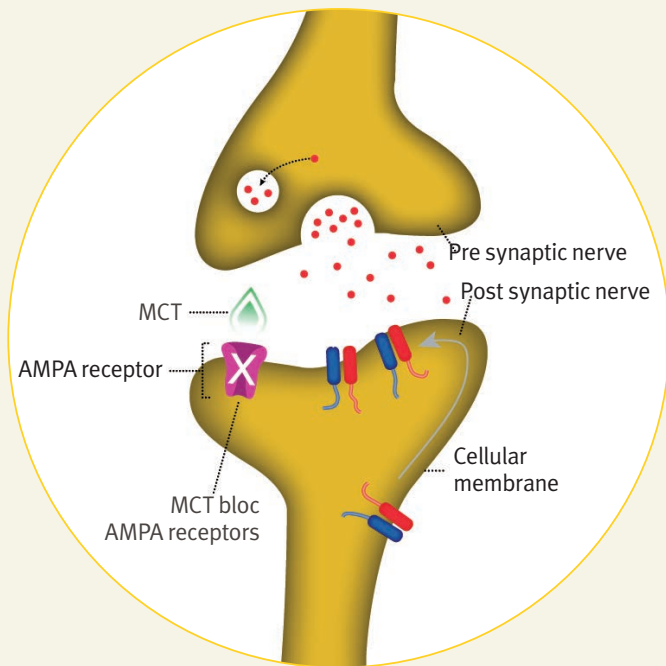
Diets and dietary supplements formulated especially for old animals exist in the market. There is evidence that dietary supplementation can be used to improve mitochondrial metabolic function and improve the oxidation mechanisms caused by the excessive release of free radicals.

These compounds include botanical oils, which are a source of intermediate chain triglycerides (MTC). The MTC increase the levels of ketones in the brain, providing an alternative source of energy to aged neurons, this results in a significant improvement in cognitive ability. In a recent study, a significant improvement was observed in all the DISHAA categories after 3 months of administration of a diet supplemented with MTC.

B vitamins, antioxidants such as vitamins C and E and selenium, docosahexaenoic (DHA) and eicosapentaenoic (EPA) oils are compounds that are often used for their anti-inflammatory effects. Arginine, on the other hand, is used in some diets and supplements to increase the synthesis of nitric oxide and thus reduce blood pressure, improving circulation and cognition. In a recent study in dogs from 9.1 to 11.5 years, a diet supplemented with a Brain Protection Blend (BPB) containing a mixture of all the components described in this paragraph has been used, and it has been observed a significant improvement in cognitive ability compared to a group of animals that did not receive this diet.

Polyunsaturated fatty acids (PUFAs), on the other hand, help maintain neuronal integrity and increase glucose utilization by neurons and are also found in some diets.





Examples of other compounds that are frequently used as dietary supplements are phosphatidylserine, which facilitates neuronal transduction and increases cholinergic transmission. L-carnitine facilitates the availability of energy and increases the signal of neuronal transmission. Tryptophan and alpha-casozepine are also common compounds in these diets and help reduce levels of anxiety and stress.

## Pharmacological therapy

The choice of drug depends, in part, on the behavioral signs that the animal shows. Selegiline may be useful in cases in which behavioral inhibition and learning difficulties are observed because this drug increases the exploratory behavior and intensity of the reinforcement experience. Serotonergic drugs such as clomipramine and fluoxetine are useful for animals suffering from chronic anxiety, hyperarousal problems or sleep disorders.

## References

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Vasodilator drugs such as propentofylline and nicergoline help to improve cerebral blood flow so they can be useful in this pathology. Benzodiazepines can be useful especially for dogs with the sleep-wake cycle affected, who do not sleep at night and bother owners too much.

## Environmental enrichment and environmental management

Continuous environmental enrichment (social and occupational) can help maintain cognitive function or slow cognitive deficit. The combination of dietary supplementation and environmental enrichment provides better results in cognitive function than if these measures are used separately.

Some geriatric dogs with cognitive deficits may be socially isolated because they demand less attention. Owners should be encouraged to interact with their dog more often. This can include invitation to the game or to caress them. Encouraging the game with other dogs can also be beneficial, as long as the dog enjoys it. In addition to social contact, it is important to offer the opportunity for the animal to be occupied for a good part of the time. For this, many different strategies can be used, such as food dispensing toys, chew toys, puzzles, training sessions, etc. This, added to routines of physical exercise, in the form of walks, games with the owner and other dogs, swimming, among others.

Finally, it must be taken into account that old dogs often have difficulty locating and accessing the resources they need. Some measures aimed at improving the accessibility of the environment are the following: add additional water dishes and near the sleeping area, add sleeping places, place ramps so that the dog can have access to different sites. In the case of blind dogs, carpets can be placed so that they indicate the dog the way to follow up to the most important resources (water, food, place of sleep, etc.) and also avoid them to bump with the furniture, leave the radio lit or place air fresheners with different scents in environments where the dog has its resources so it can locate them. In addition, it is important to establish predictable routines so that the dog has a sense of control and feels more secure.