# CANINE COGNITIVE DYSFUNCTION SYNDROME DIAGNOSIS: NEUROLOGY, ETHOLOGY AND PATHOLOGY

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The Canine Cognitive Dysfunction Syndrome (CCDS) is a neurodegenerative disease that affects 14-35% of dogs over 7 years old. Affected dogs can show signs of disorientation, altered social interactions, disrupted sleep-wake cycle, loss of habits or haouse-soiling, changes in activity levels and anxiety (DISHAA). Currently, it is presuntively diagnosed by exclusion, but definitively through histopathology of the brain.

## OBJETIVE

To evidence the need to approach the syndrome through different veterinary specialties such as ethology, neurology and pathology.

## ETHOLOGY

**Behavioral changes**: they can be due to alterations in any system of the body. Such as blindness, arthritis, *diabetes mellitus*...

**DISHAA questionnaries**: they assess, from the point of view of the owner, the patient's condition through the severity of the DISHAA clinical signs.

**Cognitive tests**: they assess directly the cognitive capacity of the dog. Impractical due to the amount of time needed to carry them out.

## PATHOLOGY

Definitive diagnosis.

**Histopathological changes**: difuse or senile plaques of amyloid-β, cerebral amyloid angiopathy, accumulations of hyperphosphorylated Tau protein, cerebral cortical atrophy, cerebral ventricular enlargement.

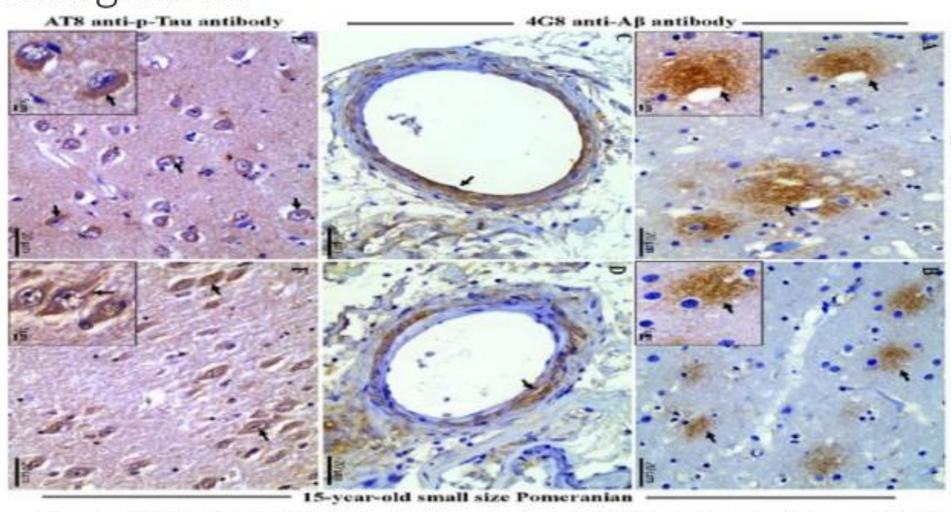


**Fig. 4.** Immunohistochemical images of Tau protein accumulations, cerebral amyloid angiopathy and accumulations of amyloid-β (Habiba *et al., 2021*).

## NEUROLOGY

**Neurological examination**: without focal deficits.

**Magnetic Resonance Imaging (MRI)**: to rule out encephalic lesions. It can evidence some alterations that can be related to the CCDS.

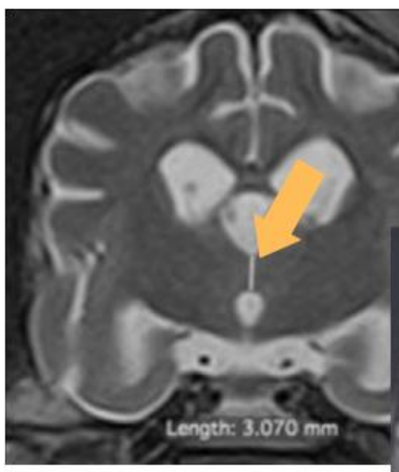


**Fig. 1.** MRI evidencing the reduction of the interthalamic adhesion's size (Dewey *et al.*, 2019).

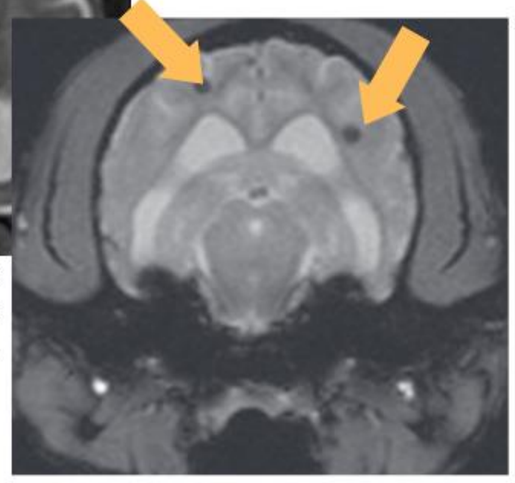

**Fig. 2.** MRI where two hypointense dots can be seen in the encephalon, compatible with microhaemorrages (Kerwin *et al.*, 2017)

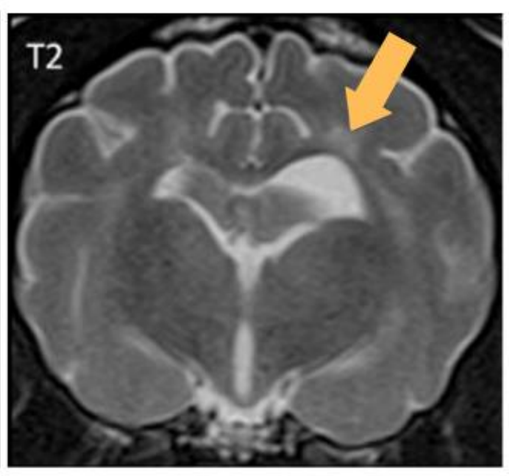


**Fig. 3.** MRI of the encephalon with an hyperintense area over one of the ventricles, known as leukoaraiosis (Dewey *et al.*, 2019).

## BIOMARKERS

**-Amiloyd-β**
**-Tau protein**
**-Short chain neurofilaments**

## CONCLUSIONS

-It is an underdiagnosed disease, wich will become increasingly common due to the increase in the geratric canine population.
-There is a need for better *in vivo* diagnostic methods for an early detection of the disease.
-It is necessary to approach the diagnosis through different veterinary specialties.
-The dog can be a good animal model to study Alzheimer's disease.

## REFERENCES

-Dewey, C. W., Davies, E. S., Xie, H., & Wakshlag, J. J. (2019). Canine Cognitive Dysfunction: Pathophysiology, Diagnosis, and Treatment. In Veterinary Clinics of North America - Small Animal Practice (Vol. 49, Issue 3, pp. 477–499). W.B. Saunders.
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-Habiba, U., Ozawa, M., Chambers, J. K., Uchida, K., Descallar, J., Nakayama, H., Summers, B. A., Morley, J. W., & Tayebi, M. (2021). Neuronal Deposition of Amyloid-Oligomers and Hyperphosphorylated Tau Is Closely Connected with Cognitive Dysfunction in Aged Dogs. Journal of Alzheimer's Disease Reports, 5, 749–760.