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MAGNETIC RESONANCE IMAGING FINDINGS OF CHIARI-LIKE MALFORMATION AND SYRINGOMYELIA IN DOGS

ASPECTE IMAGISTICE OBŢINUTE PRIN REZONANŢĂ MAGNETICĂ ÎN MALFORMAŢIA DE TIP CHIAR ŞI SIRINGOMIELIA LA CÂINI

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ABSTRACT

Magnetic Resonance Investigation (MRI) procedure is a high performance diagnostic imaging, which uses a magnetic field and radio frequency pulses which generate images of various organs and tissues investigated. In most of the cases, MRI complements the information obtained by X-ray, ultrasonography or computed tomography. Represents a minimally invasive and non-irradiated method.

Chiari-like malformation and syringomyelia represents a common condition in brachycephalic dogs, especially seen in Cavalier King Charles Spaniel and Griffon Bruxellois.

Before the appearance of the magnetic resonance imaging, diagnosis of Chiari-like malformation and/or syringomyelia has been frequently confused with various skin problems, especially allergic skin disorders, ear infections, epilepsy or discopathies. Thus, MRI is essential in diagnoses of Chiari-like malformation and/or syringomyelia, as well as of the extension of lesions and the occurrence of secondary complications.

Keywords: Magnetic Resonance Imaging, syringomyelia, Chiari-like malformation, brachycephalic

REZUMAT

Investigaţia prin Rezonanţă Magnetică (IRM) este o procedură de diagnostic imagistic de înaltă performanţă ce foloseşte un câmp magnetic si pulsuri de radiofrecvenţă ce generează imagini ale diferitelor organe şi ţesuturi investigate. În cele mai multe cazuri, IRM completează informaţiile obţinute prin radiografie, ultrasonografie sau tomografie computerizată şi reprezintă o metodă minim invazivă şi neiradiantă.

Malformaţia de tip Chiari şi Siringomielia reprezintă afecţiuni întâlnite la rasele brahicefalice, fiind în special diagnosticate la rasele Cavalier King Charles Spaniel şi Griffon Bruxellois.

Înainte de apariţia imagisticii prin rezonanţă magnetică, diagnosticul de Malformaţie de tip Chiari şi/sau siringomielie a fost frecvent confundat cu diverse afecţiuni dermatologice, in special alergii şi afecţiuni cutanate, otite, epilepsie sau discopatii. Astfel, IRM este esenţială în stabilirea dignosticului de Malformaţie de tip Chiari şi/sau siringomielie, precum şi a extinderii leziunilor şi apariţia complicaţiilor secundare.

Cuvinte cheie: Investigaţia prin Rezonanţă Magnetică, Siringomielie, malformaţia de tip Chiari, brahicefalie

Chiari like malformation (CM), also known as caudal occipital malformation syndrome (COMS) or occipital hypoplasia (OH), is a malformation of the skull, analogue to the human medical condition Arnold-Chiari malformation type I [10].

CM is characterized by a small volume of the posterior cranial fossa compared to the nervous tissue, which results in herniation of the cerebellum, and sometimes also the brainstem through the foramen magnum (communication of cranial fossa with the spinal canal). Thus, the movement of cerebrospinal fluid is disturbed, causing syringomyelia (SM) and secondary lesions [3, 11].

Syringomyelia represents a medical condition characterized by the development of cavities in the spinal cord parenchyma (syrinx) due to disturbances of cerebral spinal fluid (CSF) movement [3, 10, 11].

In most of the cases CM and SM evolve together, but these conditions may develop independently of each other. CM can progress acute or chronic, is commonly diagnosed in dogs aged from 6 months to 10 years [7].

Diagnosis of central nervous system diseases represents a major challenge, partly because of the specific anatomical peculiarities, on the other due to the commonly used imaging techniques - radiography, ultrasonography or computed tomography.Among diagnostic imaging methods described in the scientific lite-

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rature, computed tomography (CT) is useful, the caudal cranial fossa can be measured easily using this method. Radiography and ultrasonography are also described in the literature as useful imaging tools, but their limitations are quite high. The only method that can confirm the presence of CM/SM is achieved by magnetic resonance imaging [5, 12, 13, 14].

Diagnosis

CM and SM can be suspected based on the medical history and clinical symptoms corroborated with the breed. The predominant clinical sign of CM/SM is neuropathic pain, frequently localized in the head, neck and along the entire length of the spinal cord, often described as a discomfort. Other clinical signs include behavioral changes, hyperesthesia, cervical scoliosis, ataxia, paralysis, vestibular dysfunction, paralysis of the facial nerve. Pain is observed in approximately 35% of cases, expressed by allodynia (pain due to a non-painful stimulus) and dysesthesia (spontaneous sensation of discomfort) [8, 9, 10].

The gold standard for diagnosing these conditions is achieved through magnetic resonance imaging (MRI), the only disadvantage is that the patients which do not present clinical signs cannot be early diagnosed. Using MRI, the medullary cavity expansion and symmetry of the syrinx can be easily determined [7, 11].

Clinical signs are directly related to the location, size and symmetry of the medullary cavity; thus, a dog that presents a narrow and symmetric syrinx may be clinically asymptomatic, while a dog with an asymmetrical syrinx will express discomfort and neuropathic pain. However, there are cases where neuroimaging results indicated the presence of CM and SM, but without any clinical expression [1, 4, 11].

Magnetic resonance imaging findings of Chiari-like malformation

Specific MRI findings observed in CM are malformed caudal occipital bone, tendency of herniation or herniation of the cerebellum through the foramen magnum (FM), and secondary ventriculomegaly - dilatation of the entire ventricular system (Fig. 1, Fig. 2).

The CM grading system divides the condition in three grades, depending on the position of the cerebellum; from grade 0 - no sign of CM is present, to grade 2, where the cerebellum is herniated through FM (Fig. 3). However, the size of the cerebellar herniation is not correlated with the severity of clinical signs [3, 11].

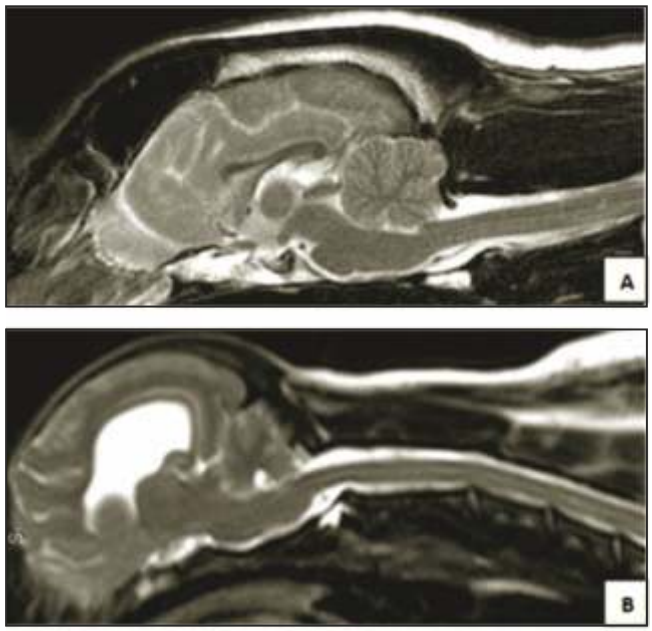

Fig. 1 – Midline sagittal T2-weighted MRI images of the brain and cervical spinal cord (fluid appears white). Cranial fossa and ventricular system comparison between a mesocephalic dog - Labrador (A) and brachycephalic dog - Cavalier King Charles Spaniel, diagnosed with CM (B). In case A the ventricular system is normal sized, while in case B it can be observed the dilatation of the ventricular system, cerebellar herniation and secondary foramen magnum obstruction.

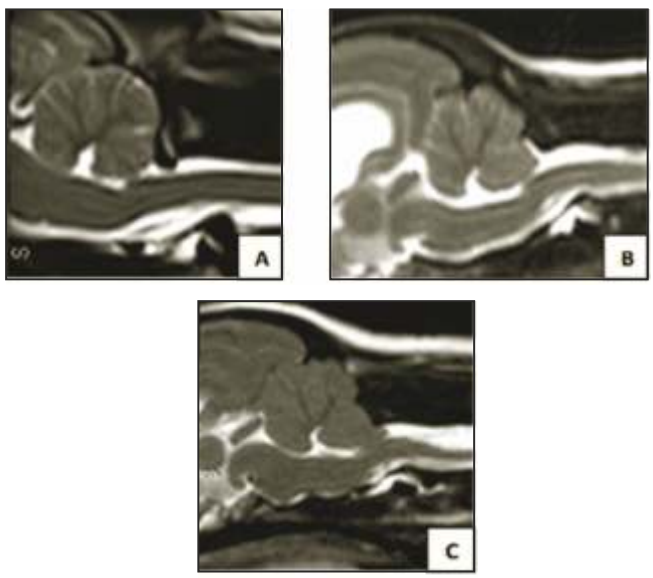

Fig. 2 – Midline sagittal T2-weighted MRI images of the cranial caudal fossa cord (fluid appears white). Comparison of cranial caudal fossa and foramen magnum between a mesocephalic dog - Labrador (A) and two brachycephalic dogs - Cavalier King Charles Spaniel (B, C). In case A the caudal cranial cavity is normal sized, well-defined, foramen magnum is unobstructed. In images B and C note different degrees of cerebellar herniation, foramen magnum is obstructed by the herniated cerebellar vermis.

Magnetic resonance imaging findings of Syringomyelia

The presence of the fluid-filled cavities in the spinal cord represents an indicator of the SM. Usually the most affected segments are the cranio cervical segment (Fig. 3) and cranial thoracic spinal cord segment (Fig. 4), however, it is recommended to examine the entire spinal cord structure, as the injuries can be located in any segment [2, 3, 11].

It is important to note that the tubular fluid-filled cavities in the spinal cord parenchyma that do not involve the central spinal canal, are defined as syringomyelia (syrinx), while hydromyelia is defined as a dilation of the central canal of the spinal cord. These two cavities may communicate with each other, but it is difficult to highlight this communication [2, 15]. In the early stages, the cavities are located dorsal and lateral to the central canal, in the grey matter. The spinal tissue around these cavities is edematous [6]. Syrinx width represents an indicator of the neuropathic pain, on which the SM grading system is based on.

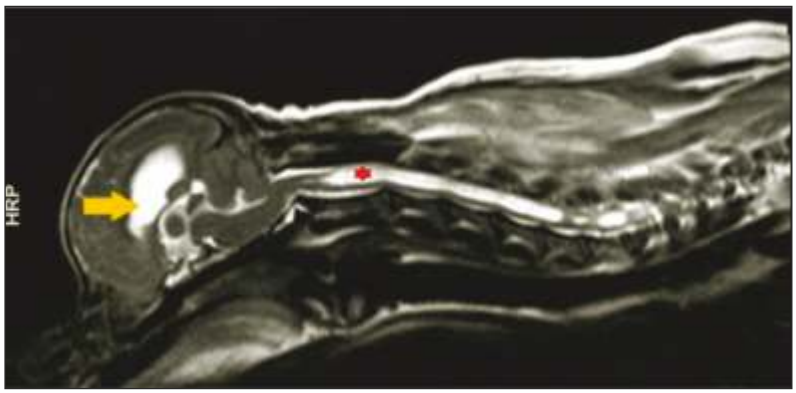

Fig. 3 – Midline sagittal T2-weighted MRI image. Note medium ventriculomegaly (yellow arrow), cerebellar herniation, syringomyelia (red star). The normal spinal cord is gray, the fluid-filled cavities are white.

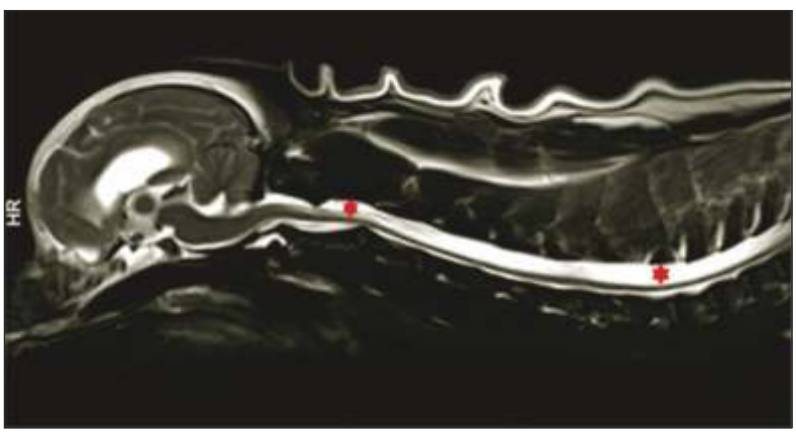

Fig. 4 – Midline sagittal T2-weighted MRI image of a 3 years old Cavalier King Charles dog, which presents severe neuropathic pain. Note the severe syringomyelia, affecting the cranio-cervical and thoracic spinal cord segments (red stars). The normal spinal cord is gray, while the fluid-filled cavities are white.

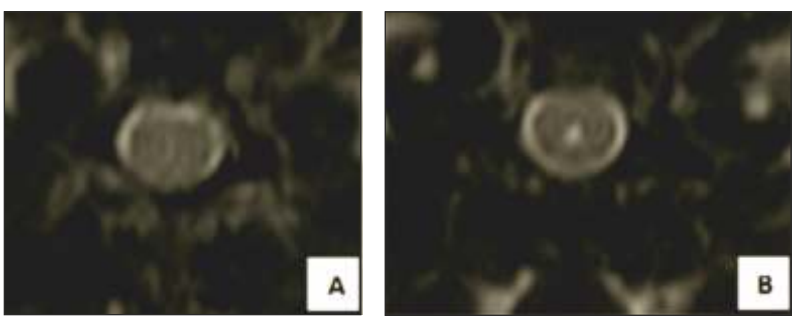

Fig. 5 – T2-weighted MRI image of the spinal cord, transvers plane. A – Normal spinal cord (Grade 0 SM); B – Central canal dilatation (Grade 1SM)

There are three types of SM, starting from grade 0 SM, where the spinal cord does not present any lesion (Fig. 5A), grade 1 SM - dilatation of the central canal or the presence of a syrinx with the internal diameter less than 2 mm; or a pre-syrinx, without the dilatation the central canal (Fig. 5B, Fig. 6); and grade 2 SM, where the syrinx diameter is greater than 2 mm (Fig. 7). The diameter of the fluid filled cavities must be measured in transverse plane. Another lesion that can be seen in SM is spinal cord edema, named pre-syrinx, considered to be a border lesion prior to the syrinx formation [3, 11].

CONCLUSIONS

MRI is one of the most modern imaging techniques, representing a non-irradiated and non-invasive method, with which higher resolution images of various organs and tissues can be obtained. Due to that, central nervous system can be easily examined, determining the neurological diagnosis. In CM and SM, MRI allows the specific measurements, based on which staging of CM and SM is performed.

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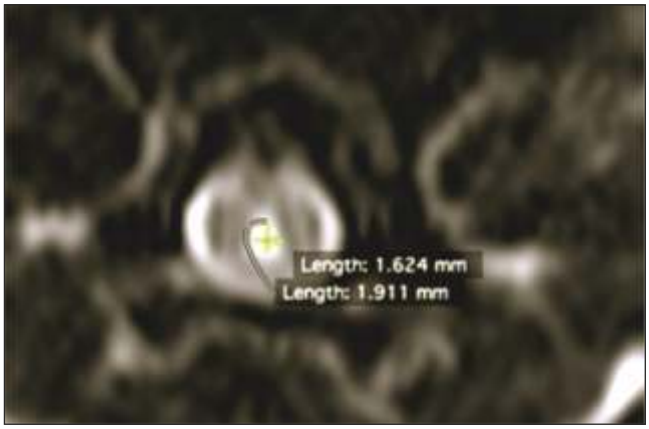

Fig. 6 – T2-weighted MRI image of the spinal cord, transvers plane. Note the presence of a fluid filled cavity with an interior diameter less than 2mm – classified as Grade 1 SM

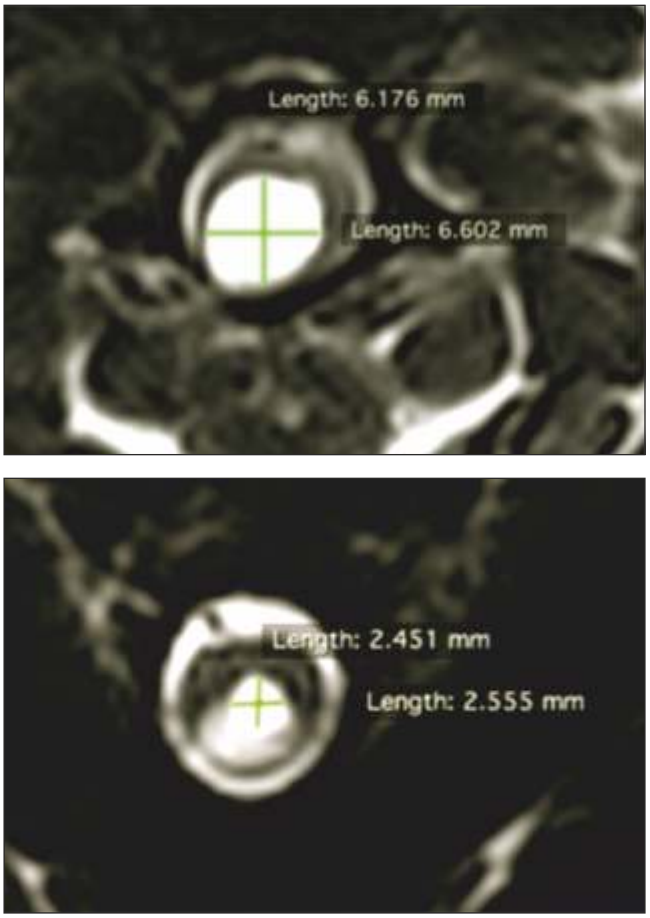

Fig. 7 – T2-weighted MRI images of the spinal cord, transvers plane. The internal diameter of the syrinx is greater than 2mm - Grade 2 SM. Note the syrinx asymmetry in both cases.

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