Scientific Works. Series C. Veterinary Medicine. Vol. LXIV (1), 2018
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

MAGNETIC RESONANCE IMAGING FINDINGS IN 46 DOGS WITH CHIARI-LIKE MALFORMATION AND SYRINGOMYELIA

Catalina Anca CUCOȘ[1], Ateș BARUT[2], Constantinescu RADU[1], Iuliana IONAȘCU[1], Constantin VLAGIOIU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Veterinary Medicine, 105 Spaiul Independenței, District 5, Bucharest, Romania
[2]PetCode Animal Hospital, Ankara, Turkey

Corresponding author email: ancacucos@gmail.com

Abstract

Chiari-like malformation is a condition characterized by a mismatch in volume between the caudal cranial fossa, which is too small, and the brain, too big, leading to foramen magnum obstruction and secondary syringomyelia – fluid filled cavities within the spinal cord parenchyma. The aim of the paper was to describe and to discuss the Chiari-like malformation and syringomyelia magnetic resonance imaging characteristics, to asses the extension and severity of the neurological lesions. This research presents a retrospective study on 46 dogs, during the period 2013-2017. All dogs were subjected to magnetic resonance imaging examination; T1- and T2-weighted transverse and sagittal images of the brain, craniocervical junction and cervical spine were obtained in all cases. Each patient was assigned a grading of Chiari-like malformation and syringomyelia, according to the British Veterinary Association/Kennel Club-Chiari-like malformation and Syringomyelia Health Scheme. Chiari-like malformation and syringomyelia were shown in all cases, and although the clinical symptoms, the breed and history generates a presumptive diagnosis, the diagnosis can only be confirmed by magnetic resonance imaging examination.

Key words*: magnetic resonance imaging, Chiari like malformation, Syringomyelia, dogs, Cavalier King Charles Spaniel.*

INTRODUCTION

Chiari-like malformation (CM) in dogs is a congenital abnormality of the caudal-occipital fossa, in which the cerebellum herniates through the foramen magnum affecting the normal cerebrospinal fluid (CSF), leading to the development of fluid filled cavities in the spinal cord parenchyma, condition named syringomyelia (SM) (Rusbridge et al., 2006).

Previously, CM/SM were considered rare conditions in veterinary medicine, but nowadays are more frequent diagnosed, part to the advanced imaging tools available in veterinary medicine - magnetic resonance imaging (MRI), and also due to the increase in popularity of the miniature and toy dog breeds.

Magnetic resonance imaging is a highly sensitive method for the detection of neurological conditions. It has an important role in determining the exact location and extent of neurological lesions.

CM and SM appears to be inherited in the Cavalier King Charles Spaniel breed (CKCS) (Lewis et al., 2010). The estimated prevalence of CM in CKCS population ranges from 92% to 100% (Couturier et al., 2008; Cerda-Gonzalez et al., 2009).

Besides the Cavalier King Charles Spaniel breed, CM and SM has been also reported in Griffon Bruxellois, Chihuahua, Pomeranian, Maltese Terrier, Pug, French Bulldog and Yorkshire Terrier (Marino et al., 2012).

The risk factors in developing CM/SM appears to be miniaturisation and brachycephalism, due to the shortened skull in this dogs (Schmidt et al., 2011; Marino et al., 2012; Driver et al., 2013).

The most common clinical signs of CM/SM are neuropathic pain, yelping, vocalization on sudden posture change, scratching – with or without skin contact, scoliosis, ataxia and weakness. Not all dogs with SM presents clinical signs, this is correlated with the syrinx asymmetry, width and spinal cord dorsal horn damage (Rusbridge et al., 2007; Rusbridge, 2013).

British Veterinary Association (BVA) proposed a CM/SM classification scheme, upon which there are 3 types of CM, based on the

anatomical position of the cerebellum, which include Grade 0 CM – normal dog, without CM, Grade 1 CM - the cerebellum is indented – mild CM, and Grade 2 CM, where the cerebellum is impacted into, or herniated through the foramen magnum; and 3 types of SM, Grade 0 SM - normal (with no syrinx or pre-syrinx and normal central canal), Grade 1 SM - Central canal dilation under two millimetres, Grade 2 SM - central canal dilation of more than 2 millimetres and a pre-syrinx or syrinx.

MATERIALS AND METHODS

The study was performed over a 4-year period, 2013-2017, on 46 dogs, of various breeds, age or gender. The mean age was 49.5 months, including 28 females and 18 males, the over representative breed was Cavalier King Charles Spaniel.

In all cases the same steps were followed: physical and neurological examination, complete blood count and serum biochemistry, MRI examination of the head and cervical spine.

Every patient included in this study presented clinical signs of CM/SM, of which neuropathic pain, scratching, spontaneous vocalization and facial rubbing were the most common.

The MRI examination was performed on dogs under general anaesthesia, placed in sternal recumbency, with the craniocervical junction in an extended position. Magnetic resonance imagining scans of the brain and cervical spine were performed in every case, and in some cases the examination also included images of the thoracic spine segments. The MRI sequences included T1- and T2-weighted transverse and sagittal images, on which an evaluation of the neurological abnormalities was performed in each case. Thus, according to the CM/SM classification scheme proposed by British Veterinary Association, to each patient was assigned a certain degree of CM and SM.

The magnetic resonance images were imported into a medical image viewer (Horos™), with which we were able to perform precise measurements of the spinal cord cavities and to evaluate the CM signs - cerebellar indentation or herniation through the foramen magnum.

The spinal cord cavities measurements were achieved in sagittal and transverse planes, aiming the length and the diameter of the syrinxes (Figure 1). According to BVA, a grade between 0 and 2 was assigned to denote severity (Table 1).

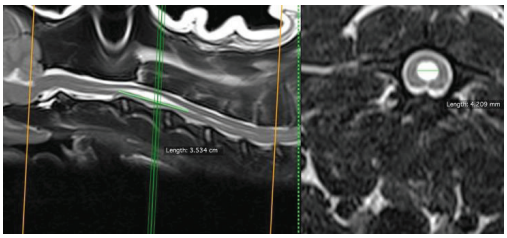

Figure 1. Magnetic resonance images from a dog with neuropathic pain. Left – mid-sagittal T2-weighted image of the cervical spinal cord. Right - transverse T2-weighted image of the spinal cord at the third cervical vertebra, illustrating a large syrinx, with the width of 4.2 mm.

Table1. Grading criteria for syringomyelia (Adapted after British Veterinary Assocication SM scheme)

Grade	Severity of syringomyelia
0	none
1	central canal dilation under two millimetres
2	central canal dilation of more than 2 millimetres, a pre-syrinx or syrinx.

The degree of cerebellar herniation was estimated according to the position of the tip of the cerebellar vermis in relation with the foramen magnum (Figure 2).

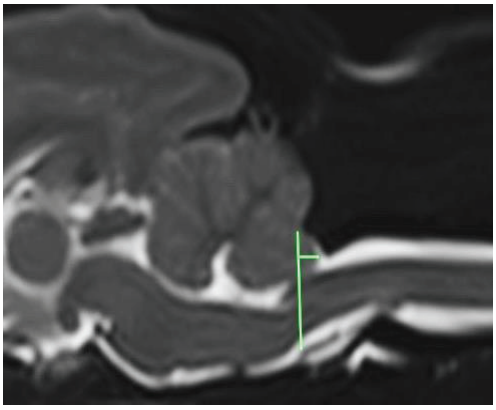

Figure 2. Mid-sagittal T2-weighted image of caudal fossa. Cerebellar herniation represents the length (horizontal line) engaged within the foramen magnum.

According to this the cerebellar herniation might be mild or marked (Figure 3).

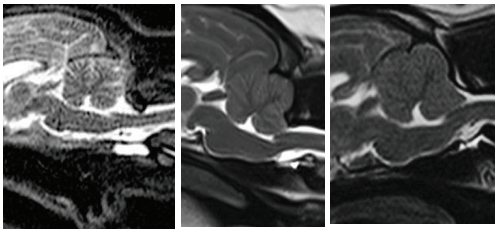

Figure 3. Mid-sagittal T2-weighted images showing a normal shaped cerebellum (left image), a mild herniation of the cerebellum (central image), and a marked deformity of the cerebellum (right image).

RESULTS AND DISCUSSIONS

The commonest magnetic resonance imaging findings were indented cerebellum, impacted or herniated cerebellum through foramen magnum, ventricular dilatation, medullary kinking, central canal dilation, cervical spinal cord syrinxes.

All of the cases presented an abnormal shaped cerebellum with overcrowding, a pointed vermis, directed caudally to the foramen magnum. In all cases the caudal part of the cerebellum presented different grades of herniation into the foramen magnum.

A study from 2014 notes that the grade of the cerebellar herniation does not predict SM, and that the cerebellar herniation progress with time (Rusbridge, 2014).

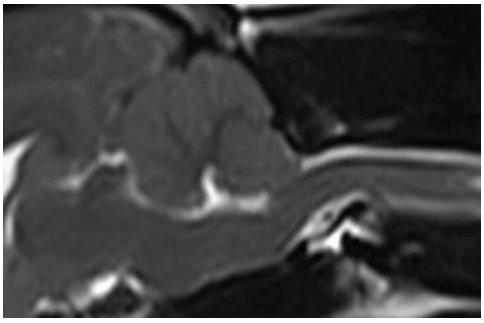

Figure 4. Mid-sagittal T2-weighted image of the caudal fossa and cranial cervical spinal cord showing medullary kinking, observed as an elevation of the medulla at the cervicomedullary junction.

Different grades of syringomyelia were observed in all 46 cases, with the transverse diameter of the syrinx ranging from under 1 mm to a maximum width of 8.3 mm. Twenty-eight dogs showed a syrinx of more than 2 mm (60,9%) compared to eighteen dogs with a syrinx less than 2 mm and/or central canal dilation (39,1%).

The syrinx length varies in each case, wide-ranging from one cervical vertebrae to almost the entire cervical spinal segment and also cranial segment of the thoracic spine (C2-T3).

Mean central canal transverse height was 3.5 mm, with a mean length of 5.6 cm.

The most common syrinx location was C2-C3 spinal segment (17.4%), followed by C3-C4 (15.2%). The MRI findings are exposed largely in Table 2.

Other MRI findings encountered were medullary kinking (Figure 4), presyrinx – spinal cord edema, that may precede syringomyelia formation (Figure 5), ventriculomegaly, bilateral otitis.

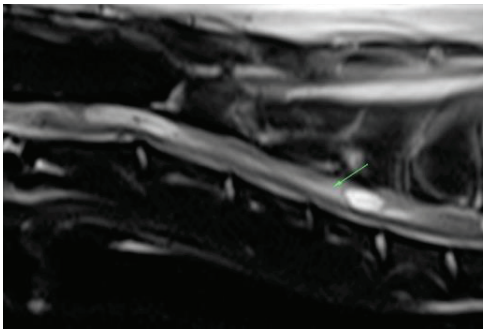

Figure 5. Mid-sagittal T2-weighted image of the cervical spinal cord segment. Note the presence of the presyrinx marked by the arrow.

Other than MRI, several diagnostic methods of CM/SM are described in the literature, these include ultrasound examination, radiography and computed tomography. However, MRI is considered the gold standard for the diagnosis of CM and SM. Ultrasonography can be used for the examination of the spinal cord and caudal fossa, but presents major limitations. Computed tomography provides important data regarding caudal cranial fossa measurements (Couturier et al., 2008).

Rusbridge in a study performed on Griffon Bruxellois dogs demonstrated that using a simple radiographic technique could be used to predict CM presence (Rusbridge et al., 2009).

Table 2. MRI abnormalities in 46 dogs with Chiari-like malformation and syringomyelia

Abnormality		Number of dogs affected
Syrinx site	C2-C3	8 cases
	C3-C4	7 cases
	C2-C4	5 cases
	C2-C5	3 cases
	Other localizations	23 cases
Syringomyelia	Grade 1 SM	18
	Grade 2 SM	28
Cerebellar herniation		46
Presyrinx		26

CONCLUSIONS

CM and SM are serious conditions that affects Cavalier King Charles Spaniel dogs and other predisposed breeds, that can be suspected based on the clinical signs and history, but it can only be confirmed by MRI.
MRI is essential for the CM/SM diagnosis, in order to fully evaluate the structural abnormalities of the central nervous system.
MRI provides accurate information that helps CM and SM staging, important for establishing the treatment, management and determining the prognosis.

REFERENCES

British Veterinary Association. (2013). Chiari Malformation/Syringomyelia Scheme (CM/SM Scheme). Canine Health Schemes http://www.bva.co.uk/canine_health_schemes/ChiariMalformationSyringomyeliaSchemeCMSMScheme.aspx: Assessed 2013 July 8.

Cerda-Gonzalez S., Olby N.J., Broadstone R., Mccullough S., Osborne J.A., 2009. Characteristics of cerebebrospinal fluid flow in Cavalier King Charles Spaniels analysed using phase velocity cine magnetic resonance imaging. Veterinary Radiology & Ultrasound 50, 467–476.

Couturier J., Rault D., Cauzinille L., 2008. Chiari-like malformation and syringomyelia in normal cavalier King Charles spaniels: a multiple diagnostic imaging approach. Journal of Small Animal Practice, 49, 438–443.

Driver C.J., Volk H.A., Rusbridge C., Van Ham L.M., 2013. An update on the pathogenesis of syringomyelia secondary to Chiari-like malformations in dogs. The Veterinary Journal, 198(3):551-9.

Lewis T., Rusbridge C., Knowler P., Blott S,. Woolliams J.A., 2010. Heritability of syringomyelia in Cavalier King Charles spaniels. The Veterinary Journal 183 (2010) 345–347

Marino D.J., Loughin C.A., Dewey C.W., Marino L.J., Sackman J.J., Lesser M.L., Akerman M.B., 2012. Morphometric features of the craniocervical junction region in dogs with suspected Chiari-like malformation determined by combined use of magnetic resonance imaging and computed tomography. American Journal of Veterinary Research 73, 105–111.

Rusbridge C., 2013. Chiari–like malformation and syringomyelia. European Journal Companian Animal Pratice, 23(3):70–89.

Rusbridge C., 2014. Chiari-like malformation and syringomyelia, Special issue on hereditary diseases, European Journal of Companion Animal Practice, 23 (3): 70-89.

Rusbridge C., Carruthers H., Dube M.P., Holmes M., Jeffery N.D., 2007. Syringomyelia in cavalier king Charles spaniels: the relationship between syrinx dimensions and pain. J Small Anim Pract 48(8):432–436.

Rusbridge C., Knowler S.P., Pieterse L., Mcfadyen A.K., 2009. Chiari-like malformation in the Griffon Bruxellois, Journal of Small Animal Practice (2009) 50, 386–393.

Rusbridge, C., Greitz, D., Iskandar, B.J., 2006. Syringomyelia: Current Concepts in Pathogenesis, Diagnosis, and Treatment. Journal of Veterinary Internal Medicine, 20: 469–479.