Retrospective study on the incidence of cats and dogs' spinal injuries by computed tomographic scan. Part I: Cervical and Cervicothoracic*

Estudo retrospectivo sobre incidência de injúrias em coluna vertebral de cães e gatos por meio de exame tomográfico. Parte I: Cervical e Cervicotorácica

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Abstract

Injuries involving the spine are frequent in dogs and knowledge of them is important to define the patient's treatment and prognosis. The objective of this retrospective study was to describe the epidemiological profile of animals and lesions in the cervical (C1-5) and cervicothoracic (C6-T2) spine diagnosed through tomographic examination. Compilation of computed tomography (CT) reports for the referred regions was carried out in a diagnostic center between 01/04/2017 and 30/04/2020, with or without contrast, from the clinical routine, in order to relate the most common lesions and their locations, as well as the species, breeds and ages most affected. A total of 1164 CT scans were performed in the period, 57.56% (n=670/1164) for the spine, with 89.7% (n=601/670) reports accessed, where both regions referred to here totaled 26.95% of the studies (n=162/601). Male mixed-breed dogs (MBD) showed the most lesions. For the cervical spine, the most identified lesion was disk extrusion and the site was C3-C4, while the mean age for lesions was 8.09±3.55 years. As for cervicothoracic, disk mineralization was more frequent and the mean age for lesions was 6.96±2.93 years. It was concluded that the spine is the main target of CT scans, that lesions related to the intervertebral disk were the main ones identified, and older MBD animals are the main ones affected.

Keywords: computed tomography, dogs, epidemiology, spinal cord, neurology.

Resumo

As lesões envolvendo coluna vertebral são frequentes em animais de companhia, podendo ocorrer à nível vertebral, medula espinal, disco intervertebral, meninges ou raízes nervosas, e o conhecimento das mesmas é importante para definir o tratamento e prognóstico do animal. O objetivo desse estudo retrospectivo foi descrever o perfil epidemiológico dos animais e das lesões em coluna vertebral cervical (C1-5) e cervicotorácica (C6-T2) diagnosticadas por meio de exame tomográfico. Realizou-se a compilação de laudos de tomografias computadorizadas para as referidas regiões realizadas em centro diagnóstico comercial, entre 01/04/2017 a 30/04/2020, contrastadas e não-contrastadas, provenientes da rotina clínica, a fim de relacionar as lesões, raças e locais mais comuns. Foram realizados 1164 exames tomográficos no período avaliado, sendo 57,56% (n=670/1164) para a coluna, com 89,7% dos laudos acessados (n=601/670), sendo que as regiões cervical e cervicotorácica somaram 26,95% dos estudos (n=162/601). Em ambas regiões, os cães sem raça definida (SRD) machos foram os que mais demonstraram lesões. Para a coluna cervical, a lesão mais identificada foi extrusão de disco e o local mais afetado foi C3-C4, enquanto a média de idade para lesões foi 8,09±3,55 anos. Já para cervicotorácica, a mineralização de disco foi mais frequente e média de idade para ocorrência de lesões foi de 6,96±2,93 anos. Concluiu-se que a coluna vertebral foi o principal alvo de tomografias, as lesões relacionadas ao disco intervertebral foram as mais identificadas, sendo animais SRD com idade avançada os mais acometidos.

Palavras-chave: cães, epidemiologia, medula espinhal, neurologia, tomografia computadorizada.

Introduction

The cervical and cervicothoracic segments of the canine spine are thus divided according to the neurological function of the arrangement of the spinal cord and nerve roots through these locations. The cervical portion is composed of seven vertebrae, C1 to C7, while the thoracic portion is formed by 13 vertebrae, T1 to T13, including the ceervicothoracic segment, whats inlcude the C5-T2 vertebrae. Between the vertebral bodies is the intervertebral disk's location, except for the atlanto-occipital joint between the skull and C1, and the atlantoaxial joint between C1 and C2, which are supported by ligaments and articular processes. One of vertebral's main function is the protection and support of the spinal cord (Singh, 2017). The intervertebral disk (IVD), through this rounded shape, is formed by a nucleus pulposus (NP) in it central region, which is lined by a anulus fibrosus (AF), and contemplates the presence of cartilaginous endplates; the meet of both regions is called the transition zone (TZ) (Decker and Fenn, 2017).

The clinical signs of vertebromedullary lesions correpond to syndromes related to the regions afected by the lesions, due to the spinal cord portion or nerve roots that were affected, showing signs of upper ou lower motor neurons in relation to the limbs and their reflexes (Costa and Moore, 2010), resulting in partial ou total, localized ou generalized neurological deficits (Jeffery et al., 2013). The use of imaging methods is indispensable for most spinal injury diagnoses. Radiography is effective in identifying some fractures and dislocations (Mendes and Bahr Arias, 2012), as well as hemivertebrae (Gutierrez-Quintana et al., 2014). However, the visualization of disk protrusions or extrusionsis and neoplastic process only done through myelography (MG), computed tomography (TC) and magnetic resonance imaging (MRI) (Besalti et al., 2016; Costa et al., 2020). MRI, due to the better definition of the image, is considered the better option, followed by contrast-enhaced CT, and lastly myelography, the later being preferable when the others are not available (Costa et al., 2020). CT can be performed with or without contrast in the spinal canal. Non-contrast-enhanced CT is sufficient for the diagnosis of Hansen's disease I in chondrodystrophic animals, although the use of contrast-enhancement is necessary to the patients that plain CT does not identify compression or in non-chondrodystrophic patients, besides facilitating the identification of the lateralization of the content (Dennison et al., 2010).

CT represents the most advanced diagnostic imaging modality available in Maringá-PR region. Therefore, this study aimed to perform a retrospective study of pathological processes of the cervical and cervicothoracic spine diagnosed by CT, in order to draw an epidemiological profile of the injuries and of the affected animals.

Material and methods

This retrospective study was conducted in the city of Maringa, Parana, Brazil, in partnership with the imaging diagnosis stablishment NAV – *Núcleo de Apoio Veterinário®*, where the tomographic reports of exams performed between 04/01/2017 to 04/30/2020 were accessed, without predilection for species, breed, sex, age and other assignments, in possession of the company's digital archive. These CT scans result from the clinical and elective routine of the establishment, being performed using a General Electric Hispeed® scanner, with single-slice technology, in sequential cuts with an average thickness of two millimeters.

The animals were submitted to general anesthesia and inhalation anesthetic maintenance for the procedure. The reports were prepared by professionals in the area of diagnostic imaging. The target regions were standardized as: cervical, cervicothoracic, thoracolumbar and lumbossacral spine. The injection of iodine-based contrast (Iopamiron® 300, Iopamidol, Bracco, Brazil) was done through the cisterna magna in the atlanto-occipital joint after trichotomy and surgical antisepsis of the area, at a dose of 0,1ml/kg, associated with 0,2ml/kg of NaCl 0,9%, in order to allow visualization of spinal compressions when necessary.

After the verification and quantification of the reports in general in the period described above, only the exams requested to the cervical (C1-5) and cervicothoracic (C5-T2) (Costa and Moore, 2010) spine were selected and accessed, although they could show vertebrae and intervertebral spaces near the margin of the regions supported by the exam, which ones were included in the statistical analysis too. Through this access and data compilation, epidemiological analyses were established about the cervical and cervicothoracic segments and the vertebrae and intervertebral spaces near this regions showed by the CT to relate the main regions of exams, as well as the occurrence of injuries and their locations, and also to identify the main affected animals and their age, sex and race predispositions. Finally, logistic regression models were considered to identify the effects of sex and age on the occurrence or not of injuries. A binary logistic regression model using the R - GNU software (version 4.0.3) was considered to determine the relationship between the occurrence of lesions in the evaluated segments and the age or sex of the affected animals. The estimates of the Odds Ratio (OR) and the 95% confidence interval were obtained from the intercept of each factor considered, based on the Wald process, in order to establish the relationship between the variables. In addition, it was performed four groups of animals according to the age, being from zero to four years, five to eight years, nine to twelve years, and thirteen to sixteen years old, in order to stablish a descritive analisis of the most commom injuries, locations and breeds.

Results

A total of 1164 tomographic exams were performed in the evaluated period, 57.56% (n=670/1164) focusing on the spine and performed only in canine animals. Of the total, 89,7% of the reports were located and accessed (n=601/670), which were computed for the analyses described. Of these 601 reports, the thoracolumbar region was identified as the main object of study, with 51.91% (n=312/601) of reports, followed by 21.8% (n=131/601) for the cervical spine, 21,13% (n=127/601) for the lumbosacral region, and 5.16% (n=31/601) for the cervicothoracic region.

For the results regarding the cervical region, of the 131 reports accessed, 68.72% (n=90/131) showed alterations, while 31.28% (n=41/131) were unaltered; lesions outside the spine unrelated to it were identified in 15.27% of the reports (n=20/131); 52.67% (n=69/131) were female animals, while 47.33% (n=62/131) were male. In 54.2% of animals (n=71/131), tomographies of other regions were performed togeher, totaling 100 regions, mainly thoracolumbar with 33% (n=33/100), skull 29% (n=29/100) and cervicothoracic 24% (24/100).

The involvement of lesions in relation to sex was expressed in figure 1. Table 1 and 2 indicate the locations and lesions that occurred in the cervical region. The total number of lesions identified was 211, indicating average of 1.61 alterations per report, where the main ones found were extrusion (43/211 – 20.38%) and mineralization (42/211 – 19.9%), followed by protrusion (41/211 – 19.43%) and spondylosis (31/211 – 14.69%). As for the site, such lesions were most commonly found in C3-4 (42/211 – 20.85%), followed by C6-7 (39/211 – 18.48%) and C4-5 (36/211 – 17.06%). The mean age of the animals submitted to the examination in years was 7,18±370, and for the occurrence of lesions it was 8.09±3.55 years.

Figure 1: Frequency of occurrence of cervical spine injuries distributed according to the sex of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020
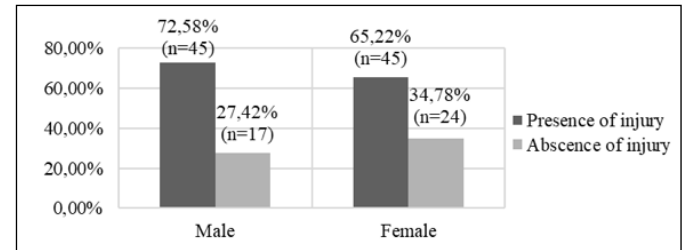

Table 1: Absolute occurrence of cervical spine (C1-5) injuries distributed according to their locations of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020.

	C1-2	C2	C2-3	C3	C3-4	C4	C4-5	C5	TOTAL
Ankylosis	0	0	1	0	1	0	0	0	**2**
Arachnoid diverticulum	0	1	0	0	0	0	0	0	**1**
Atlantoaxial subluxation	4	0	2	0	0	0	0	0	**6**
Atlanto-occipital overlapping	1	0	0	0	0	0	0	0	**1**
Discospondylits	0	0	0	0	0	0	1	0	**1**
Disk mineralization	0	0	3	0	8	0	8	0	**19**
Dystrophic calcification	0	0	0	0	1	0	1	0	**2**
Extrusion	0	0	6	0	12	0	13	0	**31**
Metastasis	0	0	0	1	0	0	0	0	**1**
Nerve root neoplasm	0	0	0	0	1	0	0	0	**1**
Protrusion	0	0	9	0	6	0	8	0	**23**
Seringohidromielia	1	0	2	0	2	0	1	0	**6**
Spinabifida	0	0	0	1	0	0	0	0	**1**
Spinal cord inflammation	0	0	1	2	3	0	2	0	**8**
Ventrolateral spondylosis	0	0	1	0	8	0	2	0	**11**
Vertebral fracture	0	1	0	0	0	1	0	0	**2**
Vertebral neoplasia	0	0	1	0	0	0	0	1	**2**
TOTAL	**6**	**2**	**26**	**4**	**42**	**1**	**36**	**1**	**118**

Table 2: Absolute occurrence of cervical spine (C5-T1 and meninges) injuries distributed according to their locations of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020.

	C5-6	C6	C6-7	C7	C7-T1	T1	Meninge	TOTAL
Bonecyst	0	0	0	0	0	1	0	**1**
Discospondylits	0	0	1	0	0	0	0	**1**
Edema	0	0	1	0	0	0	0	**1**
Epiphyseal degeneration	0	0	0	1	0	0	0	**1**
Extrusion	4	0	7	0	1	0	0	**12**
Fibrocartilaginous piston	0	0	0	1	0	0	0	**1**
Hematoma	0	0	1	0	0	0	0	**1**
Meningeal neoplasia	0	0	0	0	0	0	1	**1**
Mineralization	7	0	7	0	8	0	1	**23**
Nerve root neoplasia	1	0	1	0	1	0	0	**3**
Protrusion	6	0	9	0	3	0	0	**18**
Spinal cord inflammation	1	1	1	0	0	0	0	**3**
Spondylolisthesis	0	0	1	0	0	0	0	**1**
Transitional vertebrae	0	0	0	2	2	1	0	**5**
Ventrolateral spondylosis	3	0	10	0	7	0	0	**20**
Vertebral neoplasia	1	0	0	0	0	0	0	**1**
TOTAL	**23**	**1**	**39**	**4**	**22**	**2**	**2**	**93**

The most affected breeds were MBD (31/211 – 14.69%), followed by Lhasa Apso (25/211 – 11.85%), Dachshund (23/211 – 10.9%) and Pinscher (22/211 – 10.42%).

Extrusion was more common in males (22/42 – 52.3%) than in females (20/42 – 47.7%). MBD (mixed-breed dog) animals (8/42 – 19.05%), followed by Lhasa Apso (6/42 – 14.28%) and Dachshund (6/42 – 14.28%) were the breeds most affected by this problem. C4-5 (13/42 – 30.95%), C3-4 (12/42 – 28.57%) and C6-7 (7/42 – 16.66%) were the most affected sites. The mineralization was more frequent in males (30/42 – 71.4%) than in females (12/42 – 28.6%), and as for the breeds, Dachshund (12/42 – 28.57%) and Lhasa Apso (12/42 – 28.57%), followed by MBD (6/42 – 14.28%) had the highest cases of mineralization, occurring mainly in the intervertebral discs located at C3-4 (8/42 – 19.05%), C4-5 (8/42 – 19.05%) and C7-T11 (8/42 – 19.05%). Protrusion in males (24/41 – 58,5%) occurred in greater proportions than in females (16/42 – 41.5%), with the MBD (10/41 – 24.39%), Pinscher (7/41 – 17,07%) and Lhasa Apso (4/41 – 9.76%) breeds being the most affected, and the C2-3 (9/41 – 21,95%), C6-7 (9/41 – 21.95%) and C4-5 (8/41 – 19,51%) locations being the most predisposed. Spondylosis in females (18/31 - 58%) was more common than in males (13/31 - 42%), with Whippet (6/31 – 19.35%), Pinscher (4/31 – 12.9%) and Poodle (4/31 – 12.9%) patients having the highest incidence, and C6-7 (10/31 – 32.26%), C3-4 (8/31 – 25.8%) and C7-T1 (7/31 – 22.58%) being the most common intervertebral spaces of occurrence.

The odds ratio for cervical lesion (table 3) indicated that performing the cervical focused CT scan with lesion identification was related to the age of the animal, with a 12,878 times greater chance of finding changes in older animals than younger animals.

Table 3: Odds ratio related to the association between sex and age for the occurrence of lesions in the cervical region of the spine of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020. Confidence interval adopted was 95%.

	Odds Ratio	Confidence interval - 95%	p-value
Intercept	0,3795	(0,1463; 0,9341)	0,0391
Sex (Male)	12,406	(0,5563; 27,905)	0,5984
Age	12,878	(11,409; 14,766)	0,0001

For animals aged zero to four years, 35 lesions were identified (35/211 – 16.59%). Disk mineralization (12/35 – 34.29%) and extrusion (8/35 – 22.86%) were the most evident lesions. The affected sites were C3-4 (10/35 – 28.57%), C4-5 (6/35 – 17.14%) and C6-7 (5/35 – 14.29%), while English Bulldog (8/35 – 22.86%) and MBD (7/35 – 20%) were the most affected breeds.

In patients between five and eight years of age, 80 lesions were identified (80/211 – 37.91%), being the age group with the highest occurrence of lesions. Disk mineralization (23/80 – 28.75%), extrusion (19/80 – 23.75%) and protrusion (12/80 – 15%) were among the main diagnoses. The intervertebral spaces C4-5 (16/80 – 20%), C3-4 (14/80 – 17.5%) and C6-7 (13/80 – 16.25%) were the most affected sites, and the Dachshund and Pisncher (14/80 – 17.5%) and Lhasa Apso (11/80 – 13.75%) breeds were the most affected.

While in animals aged nine to 12 years old, 64 lesions were identified (64/211 – 30.33%), where disk protrusion (19/64 – 29,69%), ventral spondylosis (17/64 – 26,56%) and disk extrusion (12/64 – 18,75%) were the main ones. C3-4 (13/64 – 20.31%), C6-7 (13/64 – 20.31%) and C2-3 (11/64 – 17.19%) were the sites of highest occurrence. MBD (22/64 – 34.37%), Pinscher and Yorkshire (7/64 – 10.94%) were the most commonly identified breeds.

For the 13 to 16-year-old age group, 32 alterations were found (32/211 – 15.17%), with ventral spondylosis (9/32 – 28,12%), protrusion (8/32 – 25%) and disk mineralization (5/32 – 15.62%) being the most frequent. Sites C6-7 (8/32 – 25%), C4-5 (6/32 – 18.75%) and C3-4 (5/32 – 15.62%) were predominant for injury, as were the Lhasa Apso (11/32 – 34.37%) and Whippet (9/32 – 28.12%) breeds.

In the CT requested for the cervicothoracic region, in 31 reports compiled, 51,61% (n=16/31) showed alterations and 48,39% (n=15/31) were healthy; 54,84% of the animals were male (n=17/31) and 45,16% (n=14/31) were female, and lesions outside the spine, unrelated to it, were found in 12.9% of animals (n=4/31); 90.32% had another region examined (n=28/31), adding up to 57 regions, mainly cervical (27/57 – 47.37%), thoracolumbar (20/57 – 35.09%) and lumbosacral (5/57 – 8.77%).

The relation of lesions with the sex of the animals is shown in figure 2. Summing all the lesions identified, it was obtained a total of 34, with an average of 1,1 lesion per examination performed focusing on the region analyzed. The tables 4 and 5 list the lesions and their places of occurrence. The main changes identified were mineralization (7/34 – 20,59%) and vertebral metastatic neoplasia (7/34 – 20.59%), followed by ventrolateral spondylosis (5/34 – 14.71%), vertebral fracture (5/34 – 20.59%) and protrusion (4/34 – 11.76%). C6-7, C7-T1, T1-2 and T2 were the sites of most occurrence of lesions, with an incidence of 4/34 – 11.76% for each site mentioned. The mean age in years of the patients submitted to the exam was 6.56±3.53, and for the occurrence of lesions it was 6.96±2.93 years.

Figure 2: Frequency of occurrence of cervicothoracic spine injuries distributed according to the sex of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020
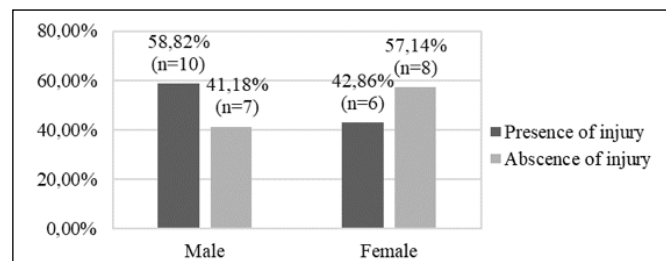
The most affected breeds were MBD (10/34 – 29,41%), Labrador Retriever (6/34 – 17.65%) and English Bulldog (5/34 – 14.70%).

Mineralization was more common in male (5/7 – 71.4%) than female (2/7 – 28.6%) while English Bulldog (3/7 – 43%) and Dachshund (2/7 – 28.57%) dogs had higher occurrence, mainly at T1-2 (3/7 – 42.86%) and C7-T1 (2/7 – 28.57%) sites. Metastasis were more frequent in males (6/7 - 86%) than in females (1/7 - 14%), with Labrador (6/7 – 86%) and MBD (1/7 – 14%) being

the most affected breeds, while the vertebrae T2 (2/7 – 28.57%) was the main place to the disease. Spondylosis occurred only in males (5/5 - 100%), mainly in the Lhasa Apso breed (3/5 – 60%) and between the T5-6 vertebrae (2/5 – 40%). Similarly, vertebral fractures occurred only in male dogs (5/5 - 100%) and MBD dogs (5/5 - 100%), mainly in the T2 vertebrae (2/5 – 40%). The protrusion was identified in the same proportions in male and females (2/4 - 50%), mainly in Yorkshire animals (2/4 – 50%), where the sites C6-7 and C7-T1 were affected, with 50% of occurrence in each.

The odds ratio for cervicothoracic lesion did not identify any statistical relationship (p>0,05) between the sex or age of the animals, using a 95% confidence interval.

Table 4: Absolute occurrence of cervicothoracic spine (C6-7 to T3-4) injuries distributed according to their locations of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020.

	C6-7	C7	C7-T1	T1	T1-2	T2	T3	T3-4	TOTAL
Bonecyst	0	0	0	1	0	0	0	0	1
Extrusion	1	0	0	0	0	0	0	0	1
Metastasis	0	1	0	1	0	2	1	0	5
Mineralization	0	0	2	0	3	0	0	0	5
Protrusion	2	0	2	0	0	0	0	0	4
Radiculopathy	0	0	0	0	1	0	0	0	1
Vertebral fractures	0	0	0	0	0	2	1	0	3
Ventrolateral Spondylosis	1	0	0	0	0	0	0	1	2
TOTAL	4	1	4	2	4	4	2	1	22

Table 5: Absolute occurrence of cervical spine (T4 to T7-8 and meninges) injuries distributed according to their locations of dogs submitted to computed tomography in the city of Maringá-PR, between 01/04/2017 to 04/30/2020.

	T4	T4-5	T5	T5-6	T6	T7-8	Meninge	TOTAL
Hemivertebrae	0	0	1	0	1	0	0	2
Meningeal neoplasia	0	0	0	0	0	0	1	1
Metastasis	0	0	1	0	1	0	0	2
Mineralization	0	1	0	0	0	1	0	2
Ventrolateral spondylosis	0	1	0	2	0	0	0	3
Vertebral fracture	1	0	1	0	0	0	0	2
TOTAL	1	2	3	2	2	1	1	12

In animals aged zero to four years, there were six lesions (6/34 – 17.65%), and disk mineralization (2/6 – 33.33%) was the most common. The T1-2 (3/6 – 50%) and T4-5 (2/6 – 33.33%) sites were most affected, while MBD animals (4/6 – 66.66%) were the most affected.

For patients aged five to eight years, there were 12 lesions (12/34 – 35,29%). Disk mineralization (5/12 – 41,66%) and ventrolateral spondylosis (3/12 – 25%) were the most identified, along with the English Bulldogs and Lhasa Apso breeds (4/12 – 33.33%). The T1-2 (3/12 – 25%) and T4-5 (2/12 – 16.67%) locations were the most affected.

In dogs aged nine to 12 years old, the highest number of lesions was found, totaling 16. C6-7 (3/16 – 18.75%) and T2 (3/16 – 18.75%) harbored the highest number of lesions, with metastatic neoplasia being the most present (7/16 – 43.75%), followed by vertebral fracture (4/16 – 25%). Labrador and MBD animals (6/16 – 37.5%) were the most frequent patients for this age group. There were no studies for patients over 12 years of age.

Discussion

With the results obtained, it was evident that the spine was the main target of CT scans and that the canine species has the largest audience for imaging analysis, confirming the expected, where the occurrence of signs related to spinal cord disorders are more commonly found in dogs compared to the feline species (Mendes and Bahr Arias, 2012), what can be one of the hypothesis for the abscence of requesting CT examination for felines, since the absence this specie in the aforementioned period with a focus on examination in the spine. The performance of concomitant scans of the cervical and skull may be justified by a certain degree of similarity between the patient's clinical signs related to the upper motor neuron correlated to the limbs (Costa and Moore, 2010), although other alterations related to the encephalic syndromes may be present. Therefore, the performance of simultaneous tomographic exams of several regions of the spine may be related, in some cases, to the inefficiency of the clinician to perform the neurological

examination and identify the region affected by the lesions, becoming him predisposed to request the analysis of more than one region at the same time. According to this, it was observed that 54.2% of animals in the group of cervical CT were submitted to CT of another region, and almost all of them (90.32%) of the cervicothoracic region were too.

Regarding cervical alterations, the arachnoid diverticulum had a low occurrence, corroborating to the literature that consider it like an uncommon lesion (Rohdinet al., 2014). It is more likely to occur in the cranial cervical region, like was shown in this paper. The same may be related to the occurrence of seringohidromyelia, which is characterized by the presence of liquor inside the spinal cord. The pug breed has a genetic predisposition to the occurrence of such alteration (Rohdinet al., 2014). In terms of the values found in the analysis, there was a low occurrence of cysts, although seringohidromyelia was morre frequent in the cervical region.

The casuistry of vertebral fractures or dislocations is generally high. It can be caused by being runnig over by cars, falls and other traumas, also bein gresponsible for signs of locomotor impairment and spinal reflexes (Mendes and Bahr Arias, 2012). This change was not among the main ones identified in this study, since the simple radiography, in most cases, is sufficient for its identification (Mendes and Bahr Arias, 2012), not requiring CT scans. Regarding the regions of study in this series, fractures and dislocations were negligible compared to other diseases. The low occurrence may be related to the fact that these segments are more stable than the others, knowing that the segment T9-L7 is more fragile because it suffers greater bending forces during trauma and, consequently, there is a greater predisposition to the occurrence of such changes (Zottiet al., 2011).

Still referring to vertebral alterations, ventral spondylosis presented a high number of cases. This alteration is characterized by calcification of the ventral longitudinal ligament and joints of the vertebrae, reaching the intervertebral space, forming a communication between the sequential vertebral bodies, and is a non-inflammatory process that causes deformation. It is mostly associated with disk degenerations nad indicates vertebral instability. This change may be an incidental diagnostic finding, not suficiente to cause clinical signs, although sites that present it are more predisposed to the occurrence of disk protrusion (Kranenburget al., 2014). Spondylosis occurred at cervical and cervicothoracic regions with the same proportion, where it was among those with the highest incidence for both; its sites of occurrence were also strongly related to cases of disk protrusion, supporting the hypothesis that it is a facilitating agent for Hansen II. It was also related to occurrence in chondrodystrophic breeds, with the exception of the cervical region, which was related to non-chondrodystrophic breeds.

The intervertebral disk disorders were presente among the main diseases in both regions evaluated. These are common to diagnosis in tomographic exams, since it is one of the main focuses for the realization of such examination, since plain radiography do not accurately identify disk changes (Costa et al., 2020). Chondrodystrophic dogs, so classified by a long bone growth disorder, have a greater predisposition to present intervertebral disk disease (IVDD), and may present it earlier compared to non-chondrodystrophic dogs (Klestyet al., 2019). Intervertebral disk mineralization occurs secondary to its degeneration (Decker

and Fenn, 2017), happening early in chondrodystrophic animals. Such breeds are predisposed to mineralization involvement, and this change predisposes to the occurrence of other intervertebral disk lesions (Decker and Fenn, 2017). For the group of patients evaluated, mineralization appeared among the main changes for the cervical and cervicothoracic regions and, as expected, the chondrodystrophic breeds were among the most affected, corroborating their epidemiological predisposition to the occurrence of early degenerations of the IVD. Knowing the highest prevalence of IVDD in chondrodystrophic dgos, it was observed that these breeds were identified among the main ones directed to the CT scans.

For the non-chondrodystrophic breeds, regarding their IVDD casuistry, there is the natural process of disk degeneration as a result of advanced age, culminating with pathological processes (Henkeet al., 2013), as structural, biomechanical and functional alteration of the disk expected in this population, related to patients with older age (Jefferyet al., 2013; Decker and Fenn, 2017). Although Hansen I IVDD is not as frequent in the thoracic segment, given the greater stability of the vertebrae provided by the ribs and due to the presence of the intercapital ligament (Singh, 2017), the cervical spine can be affected. Among the injuries related to the cervical disk diseases, there is no Wobler syndrome, which generates progressive clinical signs related to cervical compression of the spinal cord. Such signs could be caused by IVDD, such as protrusion or extrusion, or could be caused by compressions not associated with the disk (Bonelliet al., 2017). Through the data collected here, evaluating the possible causes of this syndrome, disk compression was the main one identified for the cervical region.

Intervertebral disk diseases can occur in two classical forms: anulus fibrosus fissure and extrusion of the contents of the NP into the spinal canal, being called Hansen I (Fenn et al., 2020); prolapse of the AF into the spinal canal, forming disk protrusion, also called Hansen II (Marinho et al., 2014; Fenn et al., 2020). Hansen I is characterized by the occurrence of a chondroid metaplasia, is prevalent in chondrodystrophic breeds, causing compression and inflammatory of the spinal cord, generating the clinical signs acutely (Jeffery et al., 2013; Fenn et al., 2020), and according to the literature, for te cervical region, it was identified the chondrodystrophic breeds as the second and third of highest occurrence, while the first was MBD, which could have a chondrodystrophic characteristics. While type II is characterized by fibroid metaplasia, is more related to non-chondrodystrophic dogs, with replacement of the NP by collagen fibers, favoring disk protrusion (Fenn et al., 2020), whats was too cofnrimed by the statistical analysis of this study, where non-chondrodystrophic dogs were more affected for Hansen II in the cervical region. Both of these pathological processes were found in this study, correlating to the literature that indicates high incidence of both like the main ones IVDD. Furthermore, both alterations are available to be diagnosed by CT (Decker and Fenn, 2017), what is a possible explanation to the high incidence.

Through the advancement of diagnostic methods and new anatomopathological presentations of disk diseases, new classifications of disk-associated have been proposed. A subtype of Hansen I is hydrated core disk extrusion, which also causes spinal cord compression (Decker and Fenn, 2017). For its diagnosis, plain CT is poorly able to confirm, especially in the cervical region, with the MRI being more indicated, although the

use of intravenous contrast in CT can indicate lesions compatible with such alteration (Royaux et al., 2016). Knowing the low efficacy of CT for this lesion, it was not identified in this study, and none of the myelotomography's imagging characteristics were related to this. Hansen's type III, on the other hand, is a new classification of IVDD, also called extrusion of the healthy nucleus pulposus in a non-compressive manner, in which a disk fragmente reaches the spinal cord causing injury acutely, but without identification of compressive material in the spinal canal (Decker and Fenn, 2017). In the diagnostic confirmation of Hansen III, CT is not conclusive, but is used for differentiation of compressive lesions, such as disk extrusion (Decker and Fenn, 2017). It is assumed that, as a result of the low efficacy of the CT in the last aforementioned subclassification of disk disease, they were not identified in the reports accessed for the regions treated here.

Although there is breed predisposition described, in the presente study, chondrodystrophic dogs were associated with the occurrence of both disk changes. Protrusion represents the largest casuistry in dogs, having a slow evolution, and can be asymptomatic in some cases, not being able to cause spinal cord injuries, or with chronic clical signs (Zani et al., 2018). Contrary to the data in the literature, it was identified through the survey that disk extrusion was the most frequently found disk pathological process in the cervical region, while protrusion was only the main one for the cervicothoracic spine. One of the explanations for this event is the anatomical chacateristics described above for the thoracic region, that avoid the medullary canal invsasion. And another explanation is possible related to the clinical presentation of these alterations, where the extrusion have the most hability to make clinical signs (Zuger et al., 2017), whats can convince their family to seek veterinary care and imagging diagnosis.

In addition to vertebral and disk changes, there is the possibility of cervical or cervicothoracic syndromes caused by neoplastic processes of the spine. Neoplasms affecting the spine can originate from the spinal cord, meninges, vertebrae, paravertebral nerves, adjacent soft tissues, or even from metastasis, where the signs presented will be similar, there being spinal cord compression (Bagley, 2010; Besalti et al., 2016). Among the primary neoplasms related to the spine, osteosarcoma, chondrosarcoma and fibrosarcoma can start in the vertebrae (Besalti et al., 2016). Some authors report a higher occurrence of meningiomas, which are born from the meninges (Marcasso et al., 2015; Valentim et al., 2016). Contrary to this, in this paper, tomographic evidence indicated that meningeal neoplasms were found in smaller numbers compared to vertebral or metastatic ones, which were thus classified according to the suggestive imaging features for each neoplastic origin. Literature correlates the primary neoformations to younger animals and metastatic neoplasms with the old ones. On the other hand, the least represent greater clinical casuistry in relation to vertebral primaries, generally being consequences of primary mammary or dermal naoplasms (Valentim et al., 2016). Here, it was identified that metastasis were the main form of neoplasms in cervicothoracic spine, while cervical vertebrae had a higher occurrence of primary neoplasms.

Patients affected by neurological lesions involving the spine will have the degree of signs and prognosis dependente on the intensity of the lesion, according to its extent and depth in the spinal cord, as well as the time required for intervention and treatment (Park et al., 2012). Therefore, epidemiological profiling and confirmation of offective imaging examination methods are necessary for the clinicians to intervene quickly and optimize the animal's prognosis.

Conclusion

With the presente study, aimed at the cervical and cervicothoracic spine, it has beem identified that the spine was the main target of CT scans for the evaluated diagnostic center, besides the fact that diseases related to the intervertebral disk were the main ones identified in imaging studies of the spine, affecting mostly MBD and older animals, although chondrodystrophic animals are among the most affected ones. Furthermore, it is expected that the demonstration of the breed and age predisposition will guide the clinicians to make a decision to request tests, as well as in the development of its framework of differential diagnoses.

Acknowledgements

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