The prevalence of Chiari-like malformation and Syringomyelia in several toy breeds in the Netherlands

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Introduction

Chiari-like malformation (CM) is caused by herniation of the cerebellum through the foramen magnum[1]. The herniation might be the result to the apparent mismatch in volume between the caudal brain structures and the caudal skull[2]. This condition occurs in several toy breeds like for instance the Griffon Bruxellois, chihuahua and the Cavalier king Charles Spaniel CKCS[4,5]

Syringomyelia [SM] is, defined as, a dilatation of the central canal, larger than 2 mm[6]. This condition occurs among others in toy breeds like the Chihuahua, and the dachshund. [4,8] Until now several hypotheses have been raised addressing the pathogenesis of SM. One hypothesis is that due to the herniation of the cerebellum (Chiari-like Malformation) an abnormal cerebrospinal fluid (CSF) flow arises. The abnormal flow in turn causes a sucking effect around the spinal cord and this supposedly would lead to a dilatation of the central canal and fluid-containing cavities (syrinx) within the parenchyma of the spinal cord (myelia)[9]. Another hypothesis is that the shortening of the skull base can lead to a narrowing of the jugular foramina (JF) between the cranial base synchondroses, which in turn might cause a congestion of the major venous outflow tracts of the skull and consequently to an increase of the intracranial pressure (ICP). The stenosis of the JF and a consequential vascular compromise in this opening could contribute to venous hypertension and rising ICP.
The raised ICP could further raise the CSF pulse pressure which in turn might cause CSF jets. This could be an additional pathogenetic factor for the development of SM[10,13]. In about 50 % of the Cavalier King Charles Spaniels with a herniation of the cerebellum (CM) syringomyelia occurs[9]. In an other study 60.7% of the 56 Griffon Bruxellois had CM. SM occurred with (37.5%) and without (8.9%) CM[11].

Most studies described the disorder with the CKCS. In this retroperspective study the prevalence of CM and SM in other brachycephalic dog breeds is investigated.

Aim of the study

The aim of this study is to investigate the prevalence of chiari-like malformation and syringomyelia in several toy breeds in the Netherlands.

Material and method

MRI scans were obtained from the various MRI centre in the Netherlands: ‘Dierenkliniek den Heuvel te Best’, ‘Dierenziekenhuis Drechtstreek te Dordrecht’, ‘Medisch Centrum voor Dieren te Amsterdam’, ‘Departement Gezelschapsdieren Universiteit Utrecht’ and ‘Dierenziekenhuis Drachten’.
The following breeds were selected: Affenpinscher, Griffon (we used the Griffon Bruxellois, Belge and Petit Brabacon for this research), Cavalier King Charles Spaniel, Chihuahua, Chinese Crested, English Toy Spaniel, Havanese, Italian Greyhound, Japanese Chin, Maltese, Manchester Terrier, Miniature Pinscher, Papillon, Pekingese, Pomeranian, Pug, Shih Tzu, Silky Terrier, Toy Fox Terrier, Toy Poodle, Yorkshire Terrier, Dachshund,

French Bulldog and the English Bulldog.

MRI evaluation:
The diagnosis of CM/SM is established by MRI. The hallmark is herniation of the cerebellum through the foramen magnum (CM) and dilatation of the central canal within the parenchyma of the spinal cord (SM) (figure 1 and 2).

The evaluation of CM is divided in four degrees:
Grade 0 - No abnormalities.
Grade 1 - An indented cerebellum.
Grade 2 - Misshaped cerebellum, without herniation.
Grade 3 - Herniated cerebellum through the foramen magnum.
A + is attached to the grade if the cerebellum is deformed.

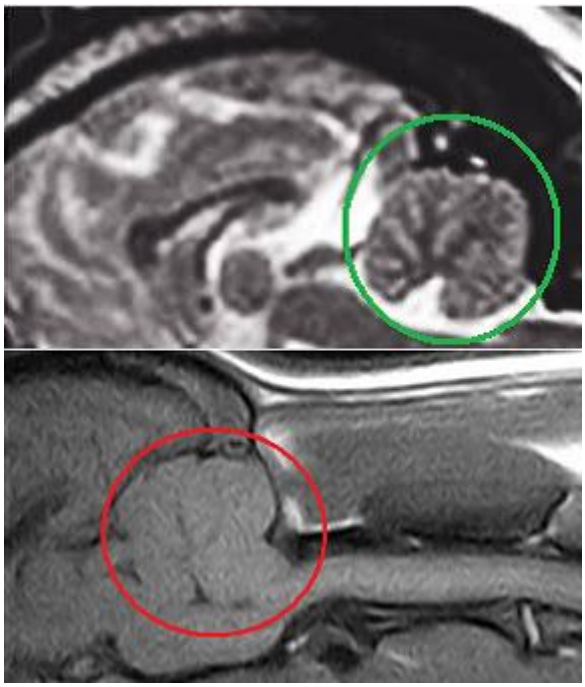

Fig. 1 Normal Cerebellum Vs. Chiari-like malformation graded 2+ [17,18]

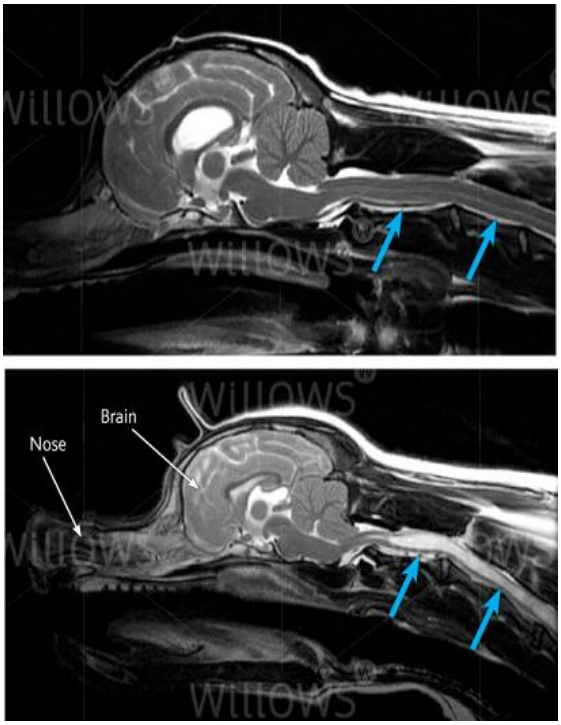

Fig. 2 Normal spinalcord versus syringomyelia (blue arrows) [19]

The evaluation of SM is divided in five groups. It is based on the central canal dilatation (in mm) an the existence of a syrinx.
Grade 0 - No abnormalities.
Grade 1 - Central canal dilitation less than 1 mm in diameter.
Grade 2 - Central canal dilitation less than 2 mm.
Grade 3 - Central canal dilitation more than 2 mm.
Grade 4 – Syringomyelia (central canal dilitation wich has an internal diameter of 2 mm or greater).
A presyrinx is qualifeid with a +.

The following data from the patients were collected: Name and adress of the owner, name, breed, age, chipnumber, regimental number and sexe of the patient. Age of the patient at time of scanning, data of the chiari-like malformation, data of the syringomyelia, UK-LFTD GR and the NL-LFTD GR. The UK-LFTD is the age-categorization of the different patients. Category A are patients of 5 years or older, category B are patients

between the 3 and 5 years and category C are patients between the 0 and 3 years. The NL-LFTD GR has also 3 categories. Category A are also patients of 5 years or older, category B are patients between the 2,5 and 5 years, and category C are patients between the 0 and 2,5 years.

Only patients with a transversal and saggital scan were selected. Only scans suitable for evaluation (eg. good quality) were included. After selection the scans where re-evaluated by a master student veterinary medicine of the university of Utrecht. The second and thirth opinions were done by a neurologist (dr. Paul Mandigers) and a radiologist (Mrs Leonie Van Bruggen) of the department of Clinical Sciences of Companion Animals (Faculty of Veterinary Medicine, Utrecht University).

Results

Scans were available from the time period January 2005 and January 2013. Only scans from the listed toy breeds were collected. All scans were made in the Netherlands but the possibility exists that a few of the included dogs were actually coming from abroad.
After selection only 236 scans remained of which 35 Chihuahua's, 1 Chinese Crested, 3 Miniature Pinschers, 3 Miniature Schnauzers, 4 English Bulldogs, 85 French Bulldogs, 26 Griffons, 5 Japanese Chin, 0 Papillons, 15 Maltese, 8 Pugs, 2 Pekingese, 4 Shih Tzu's, 1 Silky terrier, 1 Staffordshire, 23 Dachshunds, 1 Toy Poodle and 19 Yorkshire Terriers.
The patients were between the 0.2 and 13.4 years old when they were scanned (table 1).

Breed	***Number of dogs***	***Median in years***	***Range in years***
Chihuahua	*35*	*4.01*	*0.25 – 10.4*
Chinese Crested	*1*	*8.1*	*8.1*
Miniature Pinscher	*3*	*7.1*	*1.23 – 13.05*
Miniature Schnauzer	*3*	*4.6*	*1.53 – 9.01*
English Bulldog	*4*	*7.4*	*4.4 – 9.5*
French Bulldog	*85*	*4.2*	*0.56 – 9.5*
Griffon	*26*	*3.42*	*0.56 – 8.37*
Japanese Chin	*5*	*2.36*	*1.01 – 3.46*
Maltese	*15*	*5.32*	*0.51 – 12.3*
Pug	*8*	*3.12*	*0.43 - 7.53*
Pekingese	*2*	*6.78*	*4.22 – 9.36*
Shih Tzu	*4*	*5.74*	*4.6 – 7.5*
Silky Terrier	*1*	*1.47*	*1.47*
Staffordshire	*1*	*0.57*	*0.57*
Dachshund	*23*	*6.57*	*0.2 – 12.86*
Toy Poodle	*1*	*0.75*	*0.75*
Yorkshire Terrier	*19*	*5.99*	*0.33 – 13.42*
Pomeranian	*1*	*4.74*	*4.74*

Table 1 Number of dogs, median and range in years.

French Bulldog	CM	SM	CM+SM	Without CM/SM
Category C	5 (18,5%)	4 (14,8%)	5 (18,5%)	13 (48,1%)
Category B	7 (24,1%)	2 (6,9%)	9 (31%)	11 (37,9%)
Category A	4 (13,8%)	4 (13,8%)	7 (24,1%)	14 (48,3%)

Table 2. Number and percentage of CM and SM in the French Bulldog divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

French Bulldog	CM	SM	CM+SM	Without CM/SM
	16 (18,8%)	10 (11,8%)	21 (24,7%)	38 (44,7%)

Table 3. Number and percentage of CM and SM in the French Bulldog without a subdivision into the three age categories.

In total 85 French bulldogs were included and divided into three different age categories. We used the UK-LFTD age-categorization. Category C are dogs between 0 and 3 years old, category B are dogs between 3 and 5 years old and category A are dogs older than 5 years. Category C consists of 27 French Bulldogs (table 2). 18,5% of these dogs had only chiari-like malformation, 14,8% had only syringomyelia, 18,5% had chiari-like malformation and syringomyelia, and 48,1% had no chiari-like malformation and no syringomyelia.
Category B consists of 29 french bulldogs. 24,1% of these had only CM, 6,9 % had only SM, 31,0% had CM and SM, and 37,9 % had no CM and no SM. Category A consists of 29 French Bulldogs. 13,8% of these dogs had only CM, 13,8% had only SM, 24,1% of these dogs had CM and SM, and 48,3% of these dogs had no CM and no SM.

Table 3 shows the numbers and percentages of the prevalence of CM and SM in French Bulldogs without a subdivision in the age categories.The same applies to table 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37.

Chihuahua	CM	SM	CM and SM	Without CM and SM
Category C	3 (25%)	0 (0%)	6 (50%)	3 (25%)
Category B	1 (14,3%)	2 (28,5%)	3 (42,9%)	1 (14,3%)
Category A	4 (25%)	2 (12,5%)	6 (37,5%)	4 (25%)

Table 4. Number and percentage of CM and SM in the Chihuahua divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Chihuahua	CM	SM	CM and SM	Without CM and SM
	8 (22,9%)	4 (11,4%)	15 (42,9%)	8 (22,9%)

Table 5. Number and percentage of CM and SM in the Chihuahua without a subdivision into the three age categories.

In total 35 Chihuahuas were included. Category C consists of 12 Chihuahuas. 25% of these dogs had only CM, 50% had CM and SM, and 25% had no CM and no SM. Category B consists of 7 dogs. 14,3% of these dogs had only CM, 28,5% had only SM, 42,9% had CM and SM, and 14,3% had no CM and no SM. Category A consistst of 16 dogs. 25% of these dogs had only CM, 12,5% had only SM, 37,5% had CM and SM and 25% of these dogs had no CM and no SM (table 4).

Griffon	CM	SM	CM and SM	Without CM and SM
Category C	8 (53,3%)	0 (0%)	5 (35,7%)	1 (7,14%)
Category B	2 (33,3%)	0 (0%)	3 (50%)	1 (16,7%)
Category A	0 (0%)	1 (16,7%)	3 (50%)	2 (33,3%)

Table 6. Number and percentage of CM and SM in the Griffon divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Griffon	CM	SM	SM and SM	Without CM and SM
	10 (38,5%)	1 (3,9%)	11 (42,3%)	4 (15,4%)

Table 7. Number and percentage of CM and SM in the Griffon without a subdivision into the three age categories.

In total 26 Griffons were included. Category C consists of 14 dogs. 53,3 % of these dogs had only CM, 35,7% had CM and SM and 7,14% had no CM and no SM. Category B consists of 6 dogs. 33,3% had only CM, 50% had CM and SM, and 16,7% had no CM and no SM. Category A consists of 6 dogs. 16,7% had only SM and 50% had CM and SM, and 33,3 % had no CM and no SM (table 6).

Maltese	CM	SM	CM and SM	Without CM and SM
Category C	1 (33,3%)	0 (0%)	1 (33,3%)	1 (33,3%)
Category B	2 (40%)	0 (0%)	3 (60%)	0 (0%)
Category A	2 (28,6%)	0 (0%)	3 (42,9%)	2 (28,6%)

Table 8. Number and percentage of CM and SM in the Maltese divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Maltese	CM	SM	CM and SM	Without CM and SM
	5 (33,3%)	0 (0%)	7 (46,7%)	3 (20,0%)

Table 9. Number and percentage of CM and SM in the Maltese without a subdivision into the three age categories.

In total 15 Maltese were included. Category C consists of 3 of dogs. 33,3% of these dogs had only CM, 33,3% had CM and SM, and 33,3% had no CM and no SM. Category B consists of 5 dogs. 40% of these dogs had only CM and 60% of these dogs had CM and SM. Category A consists of 7 dogs. 28,6% of these dogs had only CM, 42,9% had CM and SM and 28,6% had no CM and no SM. (table 8).

Dachshund	CM	SM	CM and SM	Without CM and SM
Category C	0 (0%)	1 (25%)	0 (0%)	3 (75%)
Category B	2 (66,6%)	0 (0%)	0 (0%)	1 (33,3%)
Category A	5 (31,3%)	2 (12,5%)	0 (0%)	9 (56,3%)

Table 10. Number and percentage of CM and SM in the Dachshund divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Dachshund	CM	SM	CM and SM	Without CM and SM
	7 (30,4%)	3 (13,0%)	0 (0%)	13 (56,5%)

Table 11. Number and percentage of CM and SM in the Dachshund without a subdivision into the three age categories.

In total 23 Dachshund were included. Category C consists of 4 dogs. 25% of these dogs had only SM, 75% of these dogs had no CM and no SM. Category B consists of 3 dogs. 66,6% of these dogs had CM and 33,3% had no CM and no SM. Category A consists of 16 dogs. 31,3% had only CM, 12,5% had only SM and 56,3% had no CM and no SM (table 10).

Yorkshire Terrier	CM	SM	CM and SM	Without CM and SM
Category C	2 (40%)	2 (40%)	0 (0%)	1 (20%)
Category B	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Category A	4 (30,8%)	2 (15,4%)	6 (46,2%)	1 (7,7%)

Table 12. Number and percentage of CM and SM in the Yorkshire Terrier divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Yorkshire Terrier	CM	SM	CM and SM	Without SM and SM
	7 (36,8%)	4 (21,1%)	6 (31,6%)	2 (10,5%)

Table 13. Number and percentage of CM and SM in the Yorkshire Terrier without a subdivision into the three age categories.

In total 19 Yorkshire terrier were included. Category C consists of 5 dogs. 40% of these dogs had only CM, 40% had only SM, and 20 % had no CM and no SM. Category B consists of 1 dog. 100% of these dogs had only CM. Category A consists of 13 dogs. 30,8% of these dogs had only CM, 15,4% had only SM, 46,2% had CM

and SM and 7,7% had no CM and no SM (table 12).

In the next tables all remaining breeds are categorized. However, because there is not enough data available in these remaining breeds, this breeds are not used in these statistics.

Chinese Crested	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	0
Category B	0	0	0	0
Category A	0	0	1	0

Table 14. Number and percentage of CM and SM in the Chinese Crested divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Chinese Crested	CM	SM	CM and SM	Without CM and SM
	0	0	1	0

Table 15. Number and percentage of CM and SM in the Chinese Crested without a subdivision into the three age categories.

Miniature pinscher	CM	SM	CM and SM	Without CM SM
Category C	1	0	0	0
Category B	0	0	0	0
Category A	0	0	2	0

Table 16. Number and percentage of CM and SM in the Miniature Pinscher divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Miniature pinscher	CM	SM	CM and SM	Without CM and SM
	1	0	2	0

Table 17. Number and percentage of CM and SM in the Miniature Pinscher without a subdivision into the three age categories.

Miniature schnauzer	CM	SM	CM and SM	Without CM and SM
Category C	1	0	0	0
Category B	0	0	0	1
Category A	0	0	0	1

Table 18. Number and percentage of CM and SM in the Miniature Schnauzer divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Miniature Schnauzer	Cm	SM	CM and SM	Without CM and SM
	1	0	0	2

Table 19. Number and percentage of CM and SM in the Miniature Schnauzer without a subdivision into the three age categories.

English Bulldog	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	0
Category B	1	0	0	0
Category A	0	1	0	2

Table 20. Number and percentage of CM and SM in the English Bulldog divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

English Bulldog	CM	SM	CM and SM	Without CM and SM
	1	1	0	2

Table 21. Number and percentage of CM and SM in the English Bulldog without a subdivision into the three age categories.

Japanese Chin	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	3
Category B	0	0	0	2
Category A	0	0	0	0

Table 22. Number and percentage of CM and SM in the Japanese Chin divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Japanese Chin	CM	SM	CM and SM	Without CM and SM
	0	0	0	5

Table 23. Number and percentage of CM and SM in the Japanese Chin without a subdivision into the three age categories.

Pomeranian	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	0
Category B	0	0	1	0
Category A	0	0	0	0

Table 24. Number and percentage of CM and SM in the Pomeranian divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Poperanian	CM	SM	CM and SM	Without CM and SM
	0	0	1	0

Table 25. Number and percentage of CM and SM in the Pomeranian without a subdivision into the three age categories.

Pug	CM	SM	CM and SM	Without CM and SM
Category C	0	3	1	1
Category B	0	0	0	0
Category A	0	1	1	1

Table 26. Number and percentage of CM and SM in the Pug divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Pug	CM	SM	CM and SM	Without CM and SM
	0	4	2	2

Table 27. Number and percentage of CM and SM in the Pug without a subdivision into the three age categories.

Pekingese	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	0
Category B	0	0	1	0
Category A	1	0	0	0

Table 28. Number and percentage of CM and SM in the Pekingese divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Pekingese	CM	SM	CM and SM	Without CM and SM
	1	0	1	0

Table 29. Number and percentage of CM and SM in the Pekingese without a subdivision into the three age categories.

Shih Tzu	CM	SM	CM and SM	Without CM and SM
Category C	0	1	0	0
Category B	1	0	0	0
Category A	2	0	0	0

Table 30. Number and percentage of CM and SM in the Shih Tzu divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Shih Tzu	CM	SM	CM and SM	Without SM and SM
	3	1	0	0

Table 31. Number and percentage of CM and SM in the Shih Tzu without a subdivision into the three age categories.

Silky Terrier	CM	SM	CM and SM	Without CM and SM
Category C	0	0	1	0
Category B	0	0	0	0
Category A	0	0	0	0

Table 32. Number and percentage of CM and SM in the Silky Terrier divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Silky Terrier	CM	SM	CM and SM	Without CM and SM
	0	0	1	0

Table 33. Number and percentage of CM and SM in the Silky Terrier without a subdivision into the three age categories.

Staffordshire	CM	SM	CM and SM	Without CM and SM
Category C	0	0	0	1
Category B	0	0	0	0
Category A	0	0	0	0

Table 34. Number and percentage of CM and SM in the Staffordshire divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Staffordshire	CM	SM	CM and SM	Without CM and SM
	0	0	0	1

Table 35. Number and percentage of CM and SM in the Staffordshire without a subdivision into the three age categories.

Toy Poodle	CM	SM	CM and SM	Without CM and SM
Category C	0	0	1	0
Category B	0	0	0	0
Category A	0	0	0	0

Table 36. Number and percentage of CM and SM in the Toy Poodle divided into 3 age categories. Category C: 0 -3 years, B: 3-5 years, C: 5 years and older.

Toy Poodle	CM	SM	CM and SM	Without CM and CM
	0	0	1	0

Table 37. Number and percentage of CM and SM in the Toy Poodle without a subdivision into the three age categories.

Discussion

This study was set up to investigate the prevalence of CM/SM within the various toy breeds and to investigate the relation between CM and SM. Until now the exact incidence or even rough estimate of the prevalence of CM and SM within the toy breeds is unknown. Reports on the existence of the two disorders within the toy breeds are only incidental. Only within the CKCS and Griffon Bruxellois dogs are scanned prior to breeding to investigate the actual CM/SM status. In both breeds there seems to be a relation between CM and SM [3,5]

This study does have several limitations. First of all this study is a retrospective study. Except for the Griffon all dogs were scanned for a

reason. This information was not available. This study is therefore not an incidence study but only a prevalence study with reasonable bias as these dogs were send in for a clinical reason. Secondly the number of scans included is still rather low. Although CM/SM was observed in several toy breeds only in a few toy breeds did the numbers carry enough weight to evaluate them. Thirdly dogs were examined of various ages. As there is a clear age effect as demonstrated by Parker et al [15] this might lead to an underestimate as dogs from all ages were included.

The most common cause of syringomyelia is chiari-like malformation [12]. The hypothesis is that overcrowding of the craniocervical junction leads to an obstruction of the CSF flow through the foramen magnum [12]. But this can not explain that dogs have been seen with SM and without CM. The observation that even in dogs with severe CM, SM may be absent and vice versa SM is present in dogs with only mild CM seem to contradict this hypothesis as well. Moreover the high prevalence of CM within the CKCS makes it impossible to differentiate the two disorders from each other. Nearly all CKCS have CM [14]. Besides the CKCS there is up to now only one other breed that has been addressed in veterinary literature: the Griffon Bruxellois [5]. And even within this breed CM seems to be linked to SM. The Griffon dogs included in this study were most likely also included in the study of Knowler et al [5]. The figures observed in this study are in line with the study of Knowler et al: CM was seen in dogs with SM in 11 out 26 dogs (42.3%) and in 10 out of 26 dogs without SM (38.5%). Only in one out 26 dogs SM was observed without CM. A further limitation to this observation is the low number of dogs scanned.

Schmidt et al [7] used in his study investigation the stenosis of the jugular foramen the French Bulldog as a control. The authors used the French Bulldog because CM and SM did not occur in the French Bulldog. The results observed in this study clearly show that CM does occur in 37 (24.7 + 18.8 = 43,5%, table 2) out of 85 dogs and SM does occur in 31 (36,5%) out of 85 dogs. Similar observations were seen for the; Chihuahua; CM does occur in 23 (65.8%) out of 35 dogs and SM does occur in 19 (54.9%) out of 35 dogs; Dachshund; CM does occur in 7 (30.4%) out of 23 dogs and SM does occur in 3 (13,0%) out of 23 dogs; Yorkshire terrier; CM does occur in 13 (68.4%) out of 19 dogs and SM does occur in 10 (57.8%) out of 19 dogs.

We observed, interestingly enough, that within the French Bulldog syringomyelia could also appear in dogs without CM, 10 out of 85 dogs (11.8%). Similar observations were seen in the Chihuahua: in 4 out of 35 dogs SM was seen without CM (11.4%), Dachshund: in 3 out of 23 dogs SM was seen without CM (13,0%) and Yorkshire terrier: 4 out of 19 dogs SM was seen without CM (21.1%). This observation is in line with the postulated hypothesis of Schmidt et al [10] Schmidt et al [10] recently described a narrowing of the jugular foramina between the cranial base synchondrisis which might cause a increase of the ICP and hence an increased pressure in the central canal and subacrachnoid space. This may lead again to the central canal dilatation but CM does not need to be present in these cases. If this hypothesis is correct, and it seems to be proven by our observations, than the conclusion should be that CM is a

separate disorder from SM although is must be raised that the high co-incidental existence of the two disorders within the investigated breeds might suggest a common pathogenesis after all.

Conclusion

Chiari-like malformation and syringomyelia does occur in brachycephalic breeds like the French Bulldog (CM: (24.7 + 18.8= 43.5%), SM: 36.5%), Chihuahua (CM: 65.8%, SM: 54.9%), Dachshund (CM: 30.4%, SM: 13.0%), Yorkshire Terrier (CM: 68.4%, SM: 57.8%), Griffon (CM: 80.8%, SM: 46,2%) and Maltese (CM: 80,0%, SM: 46.7%) . The rather high prevalence makes that the two disorders are of interest for both breeders as well as veterinarian. The results are not in line with earlier results published and this means that the hypothesis that CM causes SM is, at least in a few other breeds has to be rejected.

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