

A Retrospective Study of Intervertebral Disc Herniation in Dogs in Japan: 297 Cases

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(Received 29 October 2007/Accepted 18 April 2008)

ABSTRACT. We investigated the epidemiological characteristics of intervertebral disc herniation (IVDH) in Japan in a large population using a retrospective study. The sample population was dogs (n=297) with IVDH in Japan. Medical records were reviewed for breed, sex, age, affected interspace and neurological severity. The dogs were comprised of 132 cases of cervical IVDH (C-IVDH) and 165 cases of thoracolumbar IVDH (TL-IVDH). In Japan, the Dachshund, Beagle and Shih Tzu tended to suffer from both C-IVDH and TL-IVDH. The Shiba Inu, a characteristic Japanese dog breed, suffered from both C-IVDH and TL-IVDH, although there was little data relating to the whole breed. Male dogs tended to suffer from C-IVDH and TL-IVDH at a rate almost twice that of females in Japan. Among the three predominant dog breeds, the Dachshund, Beagle and Shih Tzu, the Dachshund tended to suffer from both C-IVDH and TL-IVDH at an earlier age than the Beagle, and the Beagle tended to suffer from both C-IVDH and TL-IVDH earlier than the Shih Tzu. Among the three predominant breeds, the Shih Tzu, in particular, tended to suffer from both C-IVDH and TL-IVDH at multiple sites. Our data from Japan were in partial agreement with previous data from the U.S.A., and epidemiological characteristics of IVDH peculiar to Japan were also identified.

KEY WORDS: age at admission, canine, chondrodystrophoid dog, epidemiological study, intervertebral disc disease.

J. Vet. Med. Sci. 70(7): 701-706, 2008

Cervical and thoracolumbar intervertebral disc herniation (IVDH) is a common cause of spinal cord dysfunction in dogs seen in small animal practice [1]. Herniation of the disc causes various grades of myelopathy, including pain, paresis and sometimes permanent paralysis. The epidemiology of IVDH in dogs has been widely studied in the U.S.A., with studies investigating a variety of epidemiological factors including breed, sex, age, location of affected interspace, the time between onset of clinical signs to having a medical examination and the severity of the clinical signs. In particular, many reports have suggested that chondrodystrophoid dog breeds tend to suffer from IVDH, with a mean age at admission that differs significantly from other breeds [6, 12, 13, 18, 22]. Epidemiological data provide clinical veterinarians with an advantage prior to diagnosis or medical treatment of IVDH. However, in Japan, the epidemiological characteristics of IVDH in dogs have not been studied sufficiently [20]. Differences in the epidemiological characteristics of IVDH in dogs between the U.S.A. and Japan might exist because the characteristics of the disease may depend in part on the canine population or the living environment of the country. To establish whether this is the case, it is necessary to examine original Japanese epidemiological data for IVDH in dogs. Therefore, we investigated the epidemiological characteristics of IVDH in Japan in a large population using a retrospective study, and in particular, evaluated the association between specific breeds and

other epidemiological factors.

MATERIALS AND METHODS

The medical records of dogs diagnosed with IVDH at Nippon Veterinary Life Science University (N. V. L. U.) between June 1991 and June 2004 were reviewed, and 297 cases were identified. Almost all cases were referred by a private veterinary hospital to N. V. L. U. The dogs were diagnosed with IVDH based on signalments, clinical neurological status, radiographs, computed tomography (CT), myelography and magnetic resonance imaging (MRI). All the cases were ultimately confirmed as IVDH based on findings during surgery. Data collected from the medical records included breed, sex, age, body weight, location of the affected interspace and neurological severity based on clinical signs. The cases were divided into a cervical IVDH (C-IVDH) group and a thoracolumbar IVDH (TL-IVDH) group based on the sites of IVDH. The breeds were categorized as individual pure dog breeds as well as mixed breed. For statistical analysis, the predominant three dog breeds were used. Gender was classified as female (both intact and spayed females were included) and male (both intact and neutered males were included). Age and body weight were recorded at the initial examination at N.V.L.U. when the diagnosis of IVDH was made. Age was recorded in years, and body weight was recorded in kg. The location of the affected interspace was recorded in each dog, and the interspaces between C2/C3 and C7/T1 and between T10/11 and L5/6 were included in this study. In addition, the number of herniated discs was counted in each case. The localization of the affected interspace was based on myelography, CT,

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CT-myelograph or MRI. The grade of myelopathy in the C-IVDH group was divided into the following three categories based on neurological status according to a previous study [11] with minor modifications: grade 1, normal ambulation with neck pain; grade 2, ambulatory tetraparetic with neck pain; grade 3, nonambulatory tetraparetic. The grade of myelopathy in the TL-IVDH group was divided into the following five categories according to a previous study [24]: Grade I, spinal hyperesthesia only; Grade II, mild ataxia with motor function adequate for weight support; Grade III, severe ataxia with motor function inadequate for weight support; Grade IV, paralysis of the hind limb with intact deep pain sensation; Grade V, paralysis of the hind limb with no deep pain sensation.

The data were analyzed using analytical software (StatView for Windows, SAS Institute Inc.). For statistical analysis, the association between predominant breeds and age at admission, number of affected interspaces and grade of myelopathy were compared by one-way analysis of variance (ANOVA) followed by the Tukey-Kramer test. When analyzing the association between predominant breeds and sex, the chi square test was applied. For all tests, $P < 0.05$ was considered significant.

RESULTS

Two hundred and ninety seven cases of cervical or thoracolumbar intervertebral disc disease were analyzed in the present study. The 297 cases of IVDH were sub divided based on the sites of IVDH. Of the 297 cases, 132 cases were categorized as C-IVDH, and the remaining 165 cases were classed as TL-IVDH.

In the C-IVDH group, the breeds were categorized into individual pure dog breeds and a mixed breed group. Small- and medium-breed dogs (<20kg) comprised 97.7% (129 of 132 cases) of the C-IVDD cases. The most common breed in the C-IVDH group was the Beagle ($n=46$), and more than 34.8% of the C-IVDH cases occurred in this breed. The other main pure breeds in the C-IVDH group were the Dachshund (the miniature and standard Dachshund were grouped together, $n=17$, 12.9%) and Shih Tzu ($n=15$, 11.4%). The remaining pure breeds in the C-IVDH group are shown in Table 1. The average age at admission in the C-IVDH group was 8.2 ± 0.3 years (mean \pm S.E., min 1.0 year, max 16.0 years). The average body weight at admission in the C-IVDH group was 9.0 ± 0.5 kg (min 2.4 kg, max 40.0 kg). There were 49 females (37.1%, 18 were spayed) and 83 males (62.9%, 12 were castrated) in the C-IVDH group. One hundred and ninety-seven interspaces were affected in the 132 cases of the C-IVDH group. The average

Table 1. Summary of the C-IVDH data

| Breed | Number | | Age | B.W. | Sex (No.) | | Grade (No.) | | | Average Grade | Affected Interspace |
|-----------------------------|--------------|--|----------------|----------------|-----------------|-----------------|-------------|----|----|---------------|---------------------|
| | with C-IVDD | | | | Female (spayed) | Male (neutered) | 1 | 2 | 3 | | |
| All breeds | 132 (100.0%) | | 8.2 ± 0.3 | 9.0 ± 0.5 | 49 (18) | 83 (12) | 76 | 45 | 11 | 1.5 ± 0.1 | 1.5 ± 0.1 |
| Beagle | 46 (34.8%) | | 8.4 ± 0.5 | 12.0 ± 0.5 | 19 (7) | 27 (4) | 31 | 13 | 2 | 1.4 ± 0.1 | 1.3 ± 0.1 |
| Dachshund | 17 (12.9%) | | 7.8 ± 0.5 | 6.1 ± 0.5 | 5 (3) | 12 (2) | 11 | 5 | 1 | 1.4 ± 0.2 | 1.2 ± 0.1 |
| Shih Tzu | 15 (11.4%) | | 10.1 ± 0.7 | 6.2 ± 0.3 | 6 (1) | 9 (2) | 7 | 5 | 3 | 1.7 ± 0.2 | 1.9 ± 0.2 |
| Pomeranian | 8 (6.1%) | | 5.9 ± 0.8 | 3.5 ± 0.3 | 4 (1) | 4 (0) | 7 | 1 | 0 | 1.1 ± 0.1 | 1.5 ± 0.3 |
| Yorkshire terrier | 8 (6.1%) | | 9.3 ± 0.7 | 3.4 ± 0.2 | 3 (2) | 5 (0) | 5 | 1 | 2 | 1.6 ± 0.3 | 2.0 ± 0.3 |
| Pekingese | 5 (3.8%) | | 5.2 ± 1.4 | 5.4 ± 0.4 | 1 (1) | 4 (1) | 2 | 3 | 0 | 1.6 ± 0.3 | 1.6 ± 0.4 |
| Chihuahua | 3 (2.3%) | | 10.3 ± 1.2 | 2.7 ± 0.3 | 2 (0) | 1 (0) | 1 | 2 | 0 | 1.7 ± 0.3 | 2.0 ± 0.6 |
| Miniature Pinscher | 3 (2.3%) | | 8.3 ± 1.5 | 5.4 ± 0.2 | 0 (0) | 3 (0) | 2 | 1 | 0 | 1.3 ± 0.3 | 2.0 ± 0.6 |
| Shiba inu | 3 (2.3%) | | 10.0 ± 1.2 | $12. \pm 0.7$ | 1 (1) | 2 (1) | 2 | 1 | 0 | 1.3 ± 0.3 | 1.3 ± 0.3 |
| English cocker spaniel | 2 (1.5%) | | 6.5 ± 1.5 | 9.3 ± 0.4 | 2 (0) | 0 (0) | 1 | 1 | 0 | 1.5 ± 0.5 | 1.0 ± 0.0 |
| Shetland sheepdog | 2 (1.5%) | | 9.5 ± 4.5 | 12.3 ± 2.3 | 1 (0) | 1 (0) | 0 | 2 | 0 | 2.0 ± 0.0 | 1.0 ± 0.0 |
| Toy poodle | 2 (1.5%) | | 7.5 ± 1.5 | 4.8 ± 2.4 | 1 (1) | 1 (0) | 2 | 0 | 0 | 1.0 ± 0.0 | 1.0 ± 0.0 |
| American cocker spaniel | 1 (0.8%) | | 7.0 | 15.1 | 0 (0) | 1 (0) | 0 | 1 | 0 | 2.0 | 1.0 |
| German shepherd | 1 (0.8%) | | 4.0 | 40.0 | 0 (0) | 1 (0) | 0 | 0 | 1 | 3.0 | 1.0 |
| Golden retriever | 1 (0.8%) | | 5.0 | 35.6 | 0 (0) | 1 (0) | 0 | 1 | 0 | 2.0 | 1.0 |
| Maltese terrier | 1 (0.8%) | | 7.0 | 4.7 | 0 (0) | 1 (0) | 0 | 1 | 0 | 2.0 | 3.0 |
| Miniature schnauzer | 1 (0.8%) | | 9.0 | 7.5 | 0 (0) | 1 (0) | 1 | 0 | 0 | 1.0 | 3.0 |
| Pembroke Welsh corgi | 1 (0.8%) | | 7.0 | 18.7 | 0 (0) | 1 (1) | 0 | 1 | 0 | 2.0 | 1.0 |
| Pug | 1 (0.8%) | | 8.0 | 7.7 | 0 (0) | 1 (0) | 1 | 0 | 0 | 1.0 | 1.0 |
| Spitz | 1 (0.8%) | | 6.0 | 9.4 | 0 (0) | 1 (0) | 0 | 0 | 1 | 3.0 | 1.0 |
| West Highland white terrier | 1 (0.8%) | | 6.5 | 7.2 | 0 (0) | 1 (0) | 0 | 1 | 0 | 2.0 | 1.0 |
| Mix breed | 9 (6.8%) | | 8.9 ± 0.7 | 10.3 ± 1.2 | 4 (1) | 5 (1) | 3 | 5 | 1 | 1.8 ± 0.2 | 1.3 ± 0.2 |

C-IVDH: cervical intervertebral disc herniation. B.W.: body weight.

Age, B.W., Average Grade and Affected interspace are presented as means \pm S.E. For Sex and Grade, the numbers of cases are shown.

Table 2. Summary of the TL-IVDH data

| Breed | Number with TL-IVDD | Age | B.W. | Sex (No.) | | Grade (No.) | | | | | Average Grade | Affected Interspace |
|----------------------------|---------------------------|------------|------------|--------------------|--------------------|-------------|----|-----|----|----|------------------|------------------------|
| | | | | Female (spayed) | Male (neutered) | I | II | III | IV | V | | |
| All Breeds | 165 (100.0%) | 6.4 ± 0.2 | 7.4 ± 0.3 | 58 (11) | 107 (11) | 6 | 47 | 32 | 63 | 17 | 3.2 ± 0.1 | 1.3 ± 0.1 |
| Dachshund | 88 (53.3%) | 5.6 ± 0.2 | 5.6 ± 0.2 | 37 (9) | 51 (5) | 0 | 17 | 19 | 42 | 10 | 3.5 ± 0.1 | 1.2 ± 0.1 |
| Beagle | 22 (13.3%) | 6.6 ± 0.6 | 11.0 ± 0.5 | 4 (0) | 18 (2) | 4 | 11 | 1 | 3 | 3 | 2.6 ± 0.3 | 1.4 ± 0.1 |
| Shih Tzu | 8 (4.8%) | 8.6 ± 1.1 | 6.6 ± 0.6 | 3 (1) | 5 (1) | 0 | 2 | 2 | 4 | 0 | 3.3 ± 0.3 | 1.8 ± 0.3 |
| Pekingese | 6 (3.6%) | 3.5 ± 0.4 | 4.8 ± 0.3 | 3 (1) | 3 (1) | 0 | 2 | 1 | 1 | 2 | 3.5 ± 0.6 | 1.3 ± 0.3 |
| Pug dog | 4 (2.4%) | 8.3 ± 1.7 | 7.7 ± 0.6 | 1 (0) | 3 (1) | 0 | 3 | 1 | 0 | 0 | 2.3 ± 0.3 | 2.3 ± 0.5 |
| Shiba inu | 4 (2.4%) | 10.0 ± 1.5 | 11.5 ± 1.4 | 0 (0) | 4 (1) | 0 | 2 | 0 | 2 | 0 | 3.0 ± 0.6 | 1.3 ± 0.3 |
| American cocker spaniel | 3 (1.8%) | 5.3 ± 0.7 | 11.1 ± 1.4 | 2 (0) | 1 (0) | 0 | 1 | 1 | 1 | 0 | 3.0 ± 0.6 | 1.0 ± 0.0 |
| Maltese terrier | 3 (1.8%) | 7.3 ± 0.3 | 3.2 ± 0.8 | 1 (0) | 2 (0) | 0 | 2 | 0 | 0 | 1 | 3.0 ± 1.0 | 1.3 ± 0.3 |
| Miniature schnauzer | 3 (1.8%) | 11.3 ± 0.7 | 7.9 ± 0.7 | 1 (0) | 2 (0) | 0 | 3 | 0 | 0 | 0 | 2.0 ± 0.0 | 3.0 ± 0.0 |
| Papillon | 3 (1.8%) | 7.3 ± 3.2 | 3.0 ± 0.6 | 1 (0) | 2 (0) | 0 | 1 | 0 | 2 | 0 | 3.3 ± 0.7 | 1.3 ± 0.3 |
| Pembroke Welsh corgi | 3 (1.8%) | 10.7 ± 0.7 | 12.2 ± 0.4 | 0 (0) | 3 (0) | 0 | 0 | 1 | 2 | 0 | 3.7 ± 0.3 | 1.0 ± 0.0 |
| Pomeranian | 2 (1.2%) | 7.0 ± 2.0 | 3.9 ± 0.4 | 1 (0) | 1 (0) | 0 | 1 | 1 | 0 | 0 | 2.5 ± 0.5 | 1.5 ± 0.5 |
| Toy poodle | 2 (1.2%) | 4.5 ± 0.5 | 5.0 ± 1.0 | 0 (0) | 2 (0) | 0 | 0 | 0 | 2 | 0 | 4.0 ± 0.0 | 1.0 ± 0.0 |
| Chihuahua | 1 (0.6%) | 3.0 | 3.4 | 0 (0) | 1 (0) | 1 | 0 | 0 | 0 | 0 | 1.0 | 1.0 |
| English cocker spaniel | 1 (0.6%) | 7.0 | 13.6 | 0 (0) | 1 (0) | 0 | 0 | 1 | 0 | 0 | 3.0 | 2.0 |
| German shepherd | 1 (0.6%) | 8.0 | 40.8 | 0 (0) | 1 (0) | 0 | 1 | 0 | 0 | 0 | 2.0 | 3.0 |
| Jack Russell terrier | 1 (0.6%) | 7.0 | 9.2 | 0 (0) | 1 (0) | 0 | 0 | 0 | 1 | 0 | 4.0 | 1.0 |
| Yorkshire terrier | 1 (0.6%) | 9.0 | 2.0 | 0 (0) | 1 (0) | 1 | 0 | 0 | 0 | 0 | 1.0 | 1.0 |
| Mix breed | 9 (5.5%) | 8.7 ± 0.7 | 14.6 ± 1.3 | 4 (0) | 5 (0) | 0 | 1 | 4 | 3 | 1 | 3.4 ± 0.3 | 1.2 ± 0.2 |

TL-IVDH: thoracolumbar intervertebral disc herniation. B.W.: body weight.

Age, B.W., Average Grade and Affected interspace are presented as means ± S.E. For Sex and Grade, the numbers of cases are shown.

number of herniated discs per case was 1.5 spaces in the C-IVDH group. The most commonly affected interspaces in the C-IVDH group were C2/3 (n=64, 48.5%), C4/5 (n=42, 31.8%) and C3/4 (n=31, 23.5%). The grades of myelopathy in the C-IVDH group were categorized as grade 1 (n=76, 57.6%), grade 2 (n=45, 34.0%) and grade 3 (n=11, 8.3%). Detailed data on each breed are shown in Tables 1 and 3. The three predominant dog breeds in the C-IVDH group were selected to compare the characteristics among the predominant pure dog breeds. The predominant dog breeds in the C-IVDH group were Beagle, Dachshund and Shih Tzu. These groups were compared according to sex, age at admission, number of affected discs and grade of myelopathy. There were no significant associations between the predominant dog breeds in the C-IVDH group and age at admission (P=0.0564, Fig. 1A), sex (P=0.862) or grade of myelopathy (P=0.109, Fig. 1C). However, the average numbers of affected interspaces in the Beagle and Dachshund in the C-IVDH group (1.3 ± 0.1 sites; 1.2 ± 0.1 sites, respectively) were significantly lower than that in the Shih Tzu (1.9 ± 0.2 sites; P=0.0054, Fig. 1B).

In the TL-IVDH group, breeds were again categorized into individual pure dog breeds and mixed breed. Small- and medium-breed dogs (<20 kg) comprised 98.8% (163 of 165 cases) of the TL-IVDD cases. The most common breed in the TL-IVDH group was the Dachshund (miniature and standard Dachshund were grouped together, n=88), and more than 53.3% of the TL-IVDH cases were found in this

breed. The other main pure breeds in the TL-IVDH group were the Beagle (n=22, 13.3%) and Shih Tzu (n=8, 4.8%). The remaining pure breeds in the TL-IVDH group are shown in Table 2. The average age at admission in the TL-IVDH group was 6.4 ± 0.2 years (min 2.0 years, max 14.0 years). The average body weight at admission was 7.4 ± 0.3 kg (min 2.0 kg, max 40.8 kg). There were 58 females (35.2%, 11 were spayed) and 107 males (64.8%, 11 were castrated) in the TL-IVDH group. Two hundred and twenty-eight interspaces were affected in the 165 cases of the TL-IVDH group. The average number of affected interspaces per case was 1.3 ± 0.1 spaces in the TL-IVDH group. The most commonly affected interspaces in this group were T12/T13 (n=61, 37.0%), T13/L1 (n=53, 32.1%) and L2/L3 (n=36, 21.8%). The grades of myelopathy in the TL-IVDH group were categorized as Grade I (n=6, 3.6%), Grade II (n=47, 28.4%), Grade III (n=32, 19.4%), Grade IV (n=63, 38.2%) and Grade V (n=17, 10.3%). Detailed data on each breed are shown in Tables 2 and 4. The three predominant dog breeds in the TL-IVDH group were selected to compare the characteristics among the predominant pure dog breeds. The predominant dog breeds in the TL-IVDH group were the Dachshund, Beagle and Shih Tzu. These breeds were compared according to sex, age at admission, number of affected discs and grade of myelopathy. There were no significant associations between the predominant dog breeds in the TL-IVDH group and sex (P=0.469). However, there was a significant association between the predominant pure

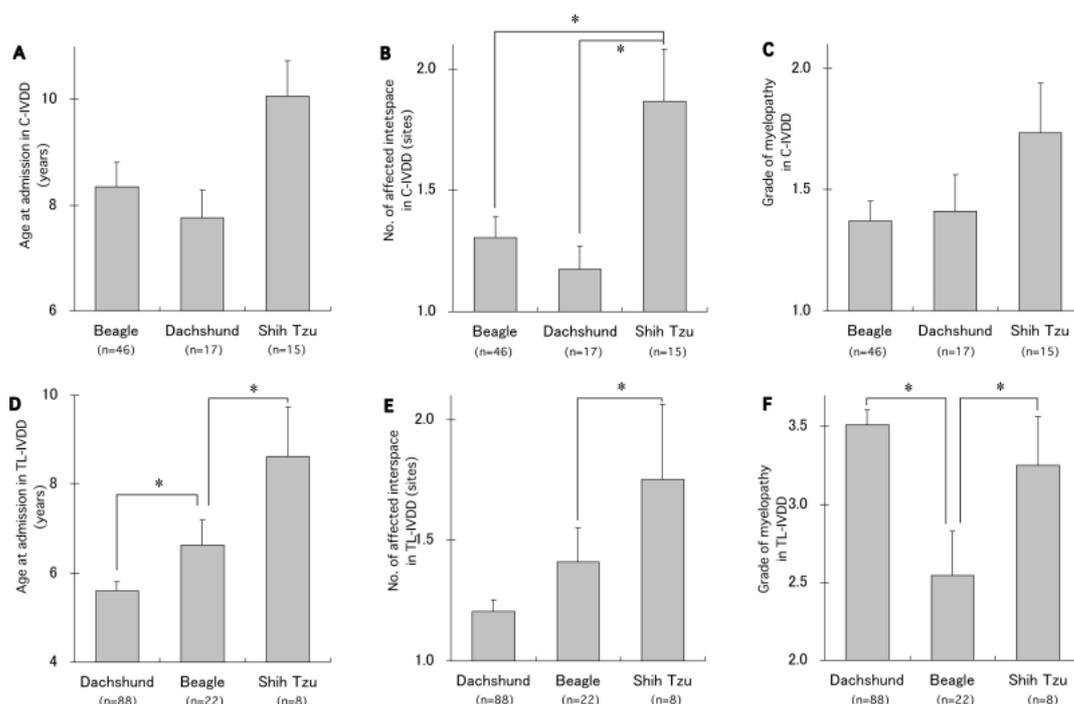


Fig. 1. Age at admission, number of affected interspaces and grade of myelopathy in the predominant dog breeds with C-IVDH and TL-IVDH. The predominant dog breeds in the C-IVDH group, the Beagle, Dachshund and Shih Tzu, were compared in relation to age at admission (A), number of affected disc spaces (B) and neurological severity grade (C). The predominant dog breeds in the TL-IVDH group, the Dachshund, Beagle and Shih Tzu, were compared in relation to age at admission (D), number of affected disc spaces (E) and neurological severity grade (F). Error bar indicates S.E. Asterisks indicate significance ($p < 0.05$). C-IVDH: cervical intervertebral disc herniation. TL-IVDH: thoracolumbar intervertebral disc herniation.

Table 3. Distribution of herniation sites in the 132 dogs with C-IVDH

| Location of Lesion | No. of Occurrences | Percentage of Occurrences in the 132 Dogs |
|--------------------|--------------------|---|
| C2/C3 | 64 | 48.50% |
| C3/C4 | 31 | 23.50% |
| C4/C5 | 42 | 31.80% |
| C5/C6 | 31 | 23.50% |
| C6/C7 | 27 | 20.50% |
| C7/T1 | 2 | 1.50% |
| Total | 197 | 149.20% |

C-IVDH: cervical intervertebral disc herniation. C: cervical vertebra.

Table 4. Distribution of herniation sites in the 165 dogs with TL-IVDH

| Location of Lesion | No. of Occurrences | Percentage of Occurrences in the 165 Dogs |
|--------------------|--------------------|---|
| T10/T11 | 3 | 1.80% |
| T11/T12 | 25 | 15.20% |
| T12/T13 | 61 | 37.00% |
| T13/L1 | 53 | 32.10% |
| L1/L2 | 26 | 15.80% |
| L2/L3 | 36 | 21.80% |
| L3/L4 | 13 | 7.90% |
| L4/L5 | 9 | 5.50% |
| L5/L6 | 2 | 1.20% |
| Total | 228 | 138.20% |

TL-IVDH: thoracolumbar intervertebral disc herniation. T: thoracicae vertebra. L: lumbar vertebra

dog breeds in the TL-IVDH group and age at admission ($P = 0.0004$, Fig. 1D). The Dachshund (5.6 ± 0.2 years) suffered from TL-IVDH at an earlier age than the Beagle (6.6 ± 0.6 years), and the Beagle suffered from TL-IVDH earlier than the Shih Tzu (8.6 ± 1.1 years). In addition, the number of affected interspaces of the Shih Tzu in the TL-IVDH group (1.8 ± 0.3 sites) was significantly higher than that of the Beagle (1.4 ± 0.1 sites; $P = 0.0123$, Fig. 1E). Finally, the Beagle had a significantly lower grade of myelopathy ($2.6 \pm$

0.3) than the Dachshund and Shih Tzu (3.5 ± 0.1 ; 3.3 ± 0.3 , respectively; $P = 0.0006$, Fig. 1F).

DISCUSSION

Evaluation of our results necessitates consideration of the source and nature of the data. The case series includes only

those cases that had been brought to the attention of a veterinarian, subsequently diagnosed, and then referred by a private veterinary hospital to N. V. L. U. Therefore, the canine sample population in this report may differ from the general clinic population. It is thus necessary to consider the data in this report with careful attention to our sample population.

In the present study, 297 cases comprising 132 cases of C-IVDH and 165 cases of TL-IVDH examined at N.V.L.U. between June 1991 and June 2004 were studied retrospectively to investigate the epidemiological characteristics of cervical and thoracolumbar IVDH in dogs in Japan. The percentages of small- and medium-breed dogs were 97.7% and 98.8% in the C-IVDD and TL-IVDD groups, respectively, and these percentages were higher than those in foreign research [4, 8, 17, 19, 21].

We evaluated various medical data for C-IVDH group. The breeds most frequently suffering from C-IVDH were the Beagle (34.8%) followed by the Dachshund (12.9%). Similar results have been reported previously, showing that the Dachshund (12.5%-43.3%) and Beagle (6.7%-17.5%) were the most frequent sufferers of C-IVDH, although the order was different from our results [4, 8, 11, 28]. The rate of this disorder in the Beagle is clearly larger in Japan than in other countries, and this may reflect the Beagle breeding rate in Japan. Age at admission in this study was in agreement with previous data that indicated a range of 7.4 to 8.2 years of age [4, 8, 11, 28]. In the current study, females made up 37.1% of the C-IVDH group and males made up the other 62.9%, and these results indicate that male dogs are almost twice as likely as females to suffer C-IVDH. The predominance of males has been reported previously [8], which agrees with our results, while other reports have indicated that both sexes are at equal risk [4, 28]. In light of these differing reports, it remains controversial whether sex can be considered a risk factor for C-IVDH. Our result suggest that sex hormones might influence the cause of C-IVDH in Japan. Upper intervertebral discs tended to be most affected in the C-IVDH group in this study. This data is in agreement with past reports [4, 8, 11]. The degree of neurological deficit of the dogs in the C-IVDH group included in this study is in close agreement with that found in a previous retrospective study of IVDH in that grades 3, 2 and 1 made up 17%, 30% and 53% of the study population, respectively [11]. The characteristics of the disease in the predominant dog breeds in the C-IVDH group in Japan, the Beagle, Dachshund and Shih Tzu, were analyzed. There were no significant associations between the predominant dog breeds in the C-IVDH group and age at admission, sex or grade of myelopathy, and this indicates that there were no differences in age at admission, sex distribution or clinical neurological severity among these three dog breeds. However, there was a significant association between the predominant dog breeds in the C-IVDH group and the number of affected interspaces in that the average number of affected interspaces in the beagle and Dachshund in the C-IVDH group was lower than that in the Shih Tzu. It should be noted that the Shih Tzu in particular, among the three pre-

dominant breeds, tends to suffer from C-IVDH at multiple sites.

We also evaluated a variety of medical data for the TL-IVDH group. In this study, the breeds most commonly suffering TL-IVDH were the Dachshund (53.3%) followed by the Beagle (13.3%). Similar results have been reported previously, showing that the Dachshund and Beagle were the breeds most commonly presenting TL-IVDH, accounting for 34.7% to 65.7% and 2.9% to 10.9% of cases, respectively [2, 3, 10, 12, 14, 16, 17, 19, 21-23]. Our data from Japan concerning the susceptibilities of other pure breeds is closely similar to previous reports from the U.S.A. Age at admission in this study agreed with previous data that indicated 5.1 to 6.5 years of age [7, 9, 15-17, 19, 21, 23, 25, 26]. In our current study, females made up 35.2% of the TL-IVDH group and males made up the other 64.8%, indicating that male dogs tend to suffer TL-IVDH, as well as C-IVDH, at a rate almost twice that of females. The majority of previous reports indicate that both sexes are at equal risk [15, 19, 21, 23], but one report from Canada is in agreement with our results [2]. Since different data have been reported, it remains controversial whether sex can be considered a risk factor for TL-IVDH. Our results suggest that sex hormones might influence the cause of TL-IVDH in Japan. The thoracolumbar spine, particularly the T11-L2 region, is affected in the majority of cases, with a reported frequency range of 66 to 86.1% [2, 5, 9, 19, 21, 25, 27]. Thus our data is in agreement with past reports. The degree of neurological deficit in the TL-IVDH group included in this study almost agrees with that of a previous study, with the exception of Grade V, in that Grade V, IV, III, II and I made up 0%, 42%, 32%, 24% and 3% of the group, respectively [24]. Other reports from the U.S.A., however, are in agreement with our data concerning Grade V, suggesting the existence of a deficit in deep pain sensation, which is defined as Grade V in our grading and which accounted for 8.1 to 10.1% [2, 16, 23]. The characteristics of the disease in the predominant dog breeds in the TL-IVDH group, the Dachshund, Beagle, and Shih Tzu, were analyzed. There were no significant associations between the predominant dog breeds in the TL-IVDH group and sex distribution, which indicated there were no differences in sex distribution among the three dog breeds. However, there were significant associations between the predominant dog breeds and age at admission and number of affected interspaces in the TL-IVDH group, and the predominant dog breeds in the TL-IVDH group could be divided roughly into two groups, the Dachshund and Beagle group and the Shih Tzu group. The Shih Tzu suffered from TL-IVDH at an older age and had a higher number of affected interspaces compared with the Dachshund and Beagle. The data indicates that the Shih Tzu tends to suffer from multiple sites of TL-IVDH at an advanced age. A significant association was shown between the predominant pure dog breeds in the TL-IVDH group and the grade of myelopathy in that the Beagle had a lower grade of myelopathy than the Dachshund and Shih Tzu. The differences in the disease characteristics in each dog breed might

originate from their genetic backgrounds or anatomical differences.

In Japan, the Shiba Inu, a characteristic Japanese dog breed, suffers from both C-IVDH and TL-IVDH, although there is little data in relation to the whole breed. The Shiba Inu can be considered for possible diagnosis of IVDH in Japan.

In summary, our data from Japan were in partial agreement with previous data from the U.S.A., and epidemiological characteristics of IVDH peculiar to Japan were also identified. We believe that our Japanese epidemiological data provide clinical veterinarians with an advantage prior to diagnosis or medical treatment of IVDH.

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