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Relationship Between the Severity of Spinal Cord Injury and the Location of Acute Intervertebral Disc Extrusion in Long-Haired Dachshunds and French Bulldogs in Taiwan

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1. Abstract

1.1. Objective: Intervertebral disc extrusion (IVDE) occurs much more frequently in Long-haired Dachshunds (LHDs) than in French Bulldogs (FBs) in Taiwan. This study investigated whether the severity of spinal cord injury is associated with the anatomical location of IVDE in these two breeds.

1.2. Study Design: Retrospective study.

1.3. Animals: A total of 264 LHDs and 41 FBs diagnosed with intervertebral disc disease (IVDD) presenting with neurological grades from 1 to 5 were included in the analysis. In addition, 25 LHDs and 10 FBs without clinical signs of IVDD served as reference cases.

1.4. Methods: The location of IVDE was identified using non-contrast computed tomography (CT). Measurements of the height, width, and cross-sectional area of extruded disc material and the corresponding intervertebral foramen were obtained from the same CT slice. All animals subsequently underwent decompressive spinal surgery, which confirmed the presence and extent of spinal cord compression.

1.5. Results: Among LHDs, IVDE occurring in the thoracic spine was associated with significantly more severe neurological deficits compared with IVDE in the lumbar region. The thoracic intervertebral foramina in these dogs were also significantly narrower in height, width, and cross-sectional area than those in the

lumbar spine. In contrast, similar anatomical differences were not observed in FBs, and the severity of neurological impairment was not clearly associated with the location of IVDE.

1.6. Conclusions: In Long-haired Dachshunds, severe neurological deficits associated with IVDE may be related to the narrower intervertebral foramina in the thoracic region. This association was not evident in French Bulldogs.

1.7. Clinical Significance: Understanding these anatomical relationships may assist clinicians in predicting the location of acute IVDE in these breeds and improve diagnostic accuracy.

2. Introduction

Spinal cord injury leading to paralysis is a major reason why pet owners consider euthanasia in veterinary practice in Taiwan. One of the most common causes of spinal cord injury in dogs is intervertebral disc disease (IVDD).

IVDD is generally classified into Hansen type I and Hansen type II. Hansen type II disease typically develops gradually and causes chronic spinal cord compression, resulting in persistent back pain and mobility problems. In contrast, Hansen type I disease involves sudden rupture of the intervertebral disc, leading to extrusion of disc material into the vertebral canal. This process, known as intervertebral disc extrusion (IVDE), often results in acute neurological deficits or paralysis.

IVDE is especially common in chondrodystrophic dog breeds, including Dachshunds, French Bulldogs, Corgis, and Poodles. By comparison, Hansen type II disease is more frequently observed in larger non-chondrodystrophic breeds such as Labrador Retrievers and Golden Retrievers.

Previous studies in the United States have shown that Dachshunds have a prevalence of IVDD approximately 10 to 12 times higher than that of most other breeds. Although both Dachshunds and French Bulldogs are classified as chondrodystrophic breeds, the incidence of IVDE appears to be considerably higher in Dachshunds than in French Bulldogs.

Several studies have attempted to explain this difference by investigating congenital abnormalities of the thoracolumbar vertebrae, but these investigations did not demonstrate clear differences between the two breeds. Therefore, other anatomical factors may contribute to the severity and location of IVDE.

The present study aimed to evaluate whether the severity of paralysis in dogs with IVDE is associated with the anatomical location of the extrusion and whether structural characteristics of

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the vertebral column differ between Long-haired Dachshunds and French Bulldogs.

3. Materials and Methods

3.1. Study Population

Between January 2020 and December 2021, 264 Long-haired Dachshunds and 41 French Bulldogs presenting with acute hind-limb paralysis were treated at Wang's Veterinary Hospital in Taipei, Taiwan.

For each patient, body weight, age, and neuter status were recorded. Prior to anesthesia, all animals underwent routine diagnostic testing, including complete blood counts, serum biochemical analysis, and electrocardiography.

Computed tomography was used to confirm the presence and location of intervertebral disc extrusion and spinal cord compression.

3.2. Neurological Assessment

Each dog underwent a comprehensive neurological examination. The severity of neurological impairment was graded using the modified Frankel scoring system, which categorizes patients into five levels based on clinical presentation.

Grade 1 indicates spinal pain without neurological deficits.

Grade 2 corresponds to ambulatory paraparesis, where the animal can still walk independently despite weakness.

Grade 3 indicates non-ambulatory paraparesis in which the patient can move the limbs but cannot walk.

Grade 4 corresponds to paraplegia with preserved deep pain perception.

Grade 5 represents paraplegia with loss of deep pain perception.

3.3. Computed Tomography Evaluation

CT imaging was performed using a helical scanner. Imaging parameters were adjusted according to body weight, and the slice thickness was set at 0.5 mm. Dogs were maintained under general anesthesia with isoflurane during imaging.

All CT images were independently evaluated by two board-certified veterinarians using specialized imaging software.

Several anatomical parameters were measured from the CT images. These included the height, width, and cross-sectional area of the extruded disc material and the corresponding dimensions of the intervertebral foramen at the same level. Ratios between the dimensions of the extruded material and the intervertebral foramen were also calculated to assess the degree of spinal canal compression.

Intervertebral foramina at unaffected levels were used as reference measurements.

3.4. Surgical Confirmation and Follow-Up

Following CT diagnosis, all patients underwent hemilaminectomy to decompress the spinal cord. The surgical procedure allowed direct confirmation of the presence and location of extruded disc material.

After surgery, the recovery of each animal was monitored and documented, including the time required to regain independent walking ability.

3.5. Statistical Analysis

All collected data were recorded in a spreadsheet and analyzed using statistical software. Differences among groups were evaluated using one-way analysis of variance, and a significance threshold of $p < 0.05$ was applied.

4. Results

4.1. Long-Haired Dachshunds

Among the 264 Long-haired Dachshunds included in the study, neurological grading varied across all five levels of severity. Most dogs were middle-aged, with an average age of approximately eight years. Dogs with the most severe neurological impairment tended to be slightly younger than those with moderate disease.

Body weight and CT attenuation values of extruded disc material did not differ significantly among neurological grades.

The ratio of the width of the extruded material to the width of the intervertebral foramen showed a significant association with the severity of neurological deficits. Dogs with the most severe paralysis exhibited higher ratios, indicating greater compression of the spinal cord.

Non-contrast CT imaging identified IVDE in the majority of LHD patients. In some cases where CT attenuation values were low, additional imaging techniques such as CT myelography or MRI were required to confirm the diagnosis.

Surgical decompression revealed that most cases involved Hansen type I disc extrusion, while a smaller number represented Hansen type II disc herniation.

Recovery outcomes were strongly related to the neurological grade before surgery. Dogs with mild neurological impairment generally recovered rapidly, whereas those with severe paralysis required longer recovery periods. Dogs lacking deep pain perception had the poorest prognosis, and only a minority regained independent walking ability.

A small number of dogs developed progressive myelomalacia after surgery and died within several days.

The most common location of IVDE in LHDs was the thoracolumbar junction, particularly the T13–L1 segment. Overall, extrusions occurring in the thoracic region were associated with more severe neurological deficits than those occurring in the lumbar spine.

4.2. French Bulldogs

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Among the 41 French Bulldogs studied, the distribution of neurological grades was similar to that observed in LHDs. However, the average age of affected FBs was slightly younger.

Body weight, CT attenuation values, and compression ratios did not show significant differences among neurological grades in this breed.

All FBs in the study were confirmed to have IVDE during surgical exploration.

Recovery time increased with the severity of neurological impairment, with the most severe cases requiring the longest rehabilitation period. Approximately half of the dogs with grade 5 paralysis regained the ability to walk independently after surgery.

One dog developed progressive myelomalacia and died shortly after paralysis onset.

In contrast to LHDs, IVDE in French Bulldogs occurred more frequently in the lumbar spine rather than the thoracic region. Furthermore, the severity of neurological impairment was not significantly associated with the anatomical location of the extrusion.

5. Discussion

Paralysis resulting from spinal cord injury represents a serious clinical and emotional challenge for both dogs and their owners. Intervertebral disc extrusion is the most common cause of acute spinal cord injury in chondrodystrophic dog breeds.

Although both Dachshunds and French Bulldogs belong to this category, Dachshunds exhibit a substantially higher prevalence of IVDE.

The findings of this study suggest that the anatomical characteristics of the vertebral column may partly explain this difference. In Long-haired Dachshunds, the thoracic intervertebral foramina were narrower than those in the lumbar region. This structural limitation may increase the severity of spinal cord compression when disc extrusion occurs.

Consequently, thoracic IVDE in Dachshunds tended to produce more severe neurological deficits than lumbar IVDE.

In contrast, the intervertebral foramina of French Bulldogs did not demonstrate significant differences between thoracic and lumbar regions. This anatomical consistency may explain why the location of IVDE was not strongly associated with neurological severity in this breed.

Another factor that may influence spinal cord injury is mechanical stress on the vertebral column. Activities involving jumping or climbing may place greater pressure on the thoracic intervertebral discs, potentially increasing the risk of extrusion in this region.

Advanced imaging techniques play an important role in diagnosing IVDE. CT scanning offers a relatively rapid and reliable diagnostic method compared with myelography or MRI. Although MRI provides the highest diagnostic accuracy, CT remains a practical

option due to shorter anesthesia times and lower procedural risks. Postoperative outcomes in this study were consistent with previous research. Dogs with mild to moderate neurological deficits typically recovered well following decompression surgery, whereas those with severe paralysis had lower recovery rates and longer rehabilitation periods.

Early surgical intervention is widely considered beneficial, particularly for dogs with loss of deep pain perception, as prompt decompression may reduce the risk of permanent spinal cord damage.

6. Conclusion

This study demonstrated that in Long-haired Dachshunds, acute intervertebral disc extrusion occurs more frequently in the thoracic spine and is associated with more severe neurological deficits than lumbar extrusion. These findings appear to be related to the narrower intervertebral foramina in the thoracic region.

In contrast, French Bulldogs did not show a clear relationship between the anatomical location of IVDE and the severity of neurological impairment.

Understanding these breed-specific anatomical differences may assist veterinarians in predicting the likely location of disc extrusion and improving the diagnosis and management of spinal cord injuries in affected dogs.

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