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Postmortem diagnoses of spinal ataxia in 316 horses in California

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Abstract

OBJECTIVE—To determine period prevalences of postmortem diagnoses for spinal cord or vertebral column lesions as underlying causes of ataxia (spinal ataxia) in horses.

ANIMALS—2,861 client-owned horses (316 with ataxia [ataxic group] and 2,545 without ataxia [control group]).

PROCEDURES—The medical records database of the University of California-Davis Veterinary Medical Teaching Hospital was searched to identify horses necropsied between January 1, 2005, and December 31, 2017. Results were compared between the ataxic and control groups and

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a. R: A language and environment for statistical computing, version 3.6.1, R Foundation for Statistical Computing, Vienna, Austria.

between various groups of horses in the ataxic group. Period prevalences were determined for the most common causes of ataxia.

RESULTS—2,861 horses underwent full necropsy, and the period prevalences for the most common definitive diagnoses for ataxia were 2.7% (77/2,861) for cervical vertebral compressive myelopathy (CVCM), 1.3% (38/2,861) for equine neuroaxonal dystrophy or equine degenerative myeloencephalopathy (eNAD-EDM), and 0.9% (25/2,861) for trauma; the period prevalence of ataxia of unknown origin was 2.0% (56/2,861). Horses in the ataxic group (vs the control group) were more likely to have been warmblood horses (OR, 2.70) and less likely to have been Arabian horses (OR, 0.53). In the ataxic group, horses < 5 (vs ≥ 5) years of age had greater odds of CVCM (OR, 2.82) or eNAD-EDM (OR, 6.17) versus trauma or ataxia of unknown origin. Horses in the ataxic group with CVCM were more likely Thoroughbreds (OR, 2.54), whereas horses with eNAD-EDM were more likely American Quarter Horses (OR, 2.95) and less likely Thoroughbreds (OR, 0.11).

CONCLUSIONS AND CLINICAL RELEVANCE—Results indicated that breed distributions differed for horses with CVCM versus eNAD-EDM; therefore, breed should be considered in the clinical evaluation of spinal ataxia in horses.

The prevalences of underlying causes of ataxia attributed to lesions in the spinal cord or vertebral column (spinal ataxia) in horses are not well-defined. Ataxia in horses is defined clinically as vestibular, cerebellar, or spinal in origin,[1] and spinal ataxia can also refer to general proprioceptive ataxia. Although diagnosis of EPM,[2] equine herpesvirus myeloencephalopathy,[3] West Nile virus infection,[4] trauma,[5] THO,[6] and EMND[7] is possible antemortem, diagnostic procedures needed to definitively diagnose CVCM and eNAD-EDM are not available antemortem. In addition, few differences in clinical signs have been reported for the primary causes of spinal ataxia (CVCM, eNAD-EDM, and EPM) in horses.[8] Although a presumptive diagnosis of CVCM can be supported with antemortem findings, a definitive diagnosis of either CVCM or eNAD-EDM requires careful gross and histologic evaluation of the CNS at necropsy.[8–10] Furthermore, many horses with ataxia are euthanized owing to poor prognosis and thus may not undergo complete histologic evaluation of central or peripheral nervous system tissues.

A prospective study[11] of 81 horses with spinal cord disease shows that EPM (n = 32) and EDM (23) were most commonly diagnosed between 1974 and 1976, and a retrospective study[12] of 19 horses with ataxia between 1985 and 1988 indicates that CVCM (12) and EDM (4) were the most common causes of spinal ataxia. Although there were sample size limitations and differences in study designs, results of both studies[11,12] indicate similar leading underlying causes of spinal ataxia.

Over the past 30 years, postmortem evaluation of neurologic disease in horses has expanded, and many universities have veterinary pathologists who specialize in neuropathology. However, to our knowledge, there have been no retrospective studies on the prevalences of diseases causing spinal ataxia in horses in the western United States. The purpose of the study reported here was to assess the period prevalences of underlying causes of spinal ataxia in horses euthanized and subsequently necropsied at the UCD VMTH between

January 1, 2005, and December 31, 2017. We hypothesized that CVCM and eNAD-EDM were leading causes of spinal ataxia in the study population.

Materials and Methods

Animals

A search of the medical records database at the UCD VMTH was performed to find records of horses necropsied between January 1, 2005, and December 31, 2017. All horses that were examined and later died or were euthanized at the UCD VMTH were eligible for full postmortem evaluation at no additional cost to the client.

Ataxic group——With the use of the search term *atax**, records of necropsied horses with variations of the term ataxia documented in their medical record were identified. The inclusion criteria were horses that had been examined by a large animal service (inpatient, outpatient, field, or emergency service) of the UCD VMTH, were identified as ataxic or having had proprioceptive deficits, and ultimately died or were euthanized and that had undergone a full neurologic necropsy. A full neurologic necropsy included removal and evaluation (gross and histologic) of the brain and spinal cord. Segments of the spinal cord were sectioned, and priority for histologic analyses was given to regions of interest on the basis of antemortem and gross postmortem findings; thus, histologic evaluation was not required for all segments of the spinal cord. Horses with extensive tissue autolysis were excluded. Clinicians (CJF and MA) determined a final diagnosis for the underlying cause of ataxia in each horse on the basis of gross and histologic pathological reports. When discrepancies in a diagnosis occurred, these clinicians deliberated until agreement on a diagnosis was reached.

Control group——Necropsied horses without the search term *atax** in their medical record were assigned to the control group. Stillborn foals and aborted fetuses were excluded.

Data collection

Data collected from the medical records of horses in both groups included date of birth, date of death, breed or type, and sex. Also, data pertaining to neurologic diagnoses were collected for horses in the ataxic group.

Breed or type——Horses were grouped into breed or type categories for analysis. These categories included American Paint Horse, AQH, Arabian Horse, draft horses (Clydesdale, Friesian, Percheron, and Shire horses), Iberian breeds (Andalusian, Lipizzaner, and Lusitano horses), miniature horses, Mustang, ponies, Standardbred, Tennessee Walking Horse, Thoroughbred, warmblood horses (Cleveland Bay, Dutch Warmblood, German Warmblood, Hanoverian, Holsteiner, Oldenburg, Selle Francais, Swedish Warmblood, and Trakehner horses), crosses (any horse of mixed breeding between 2 major identified breeds [eg, AQH and Thoroughbred]), and other (horses reported as crossbred or of a breed or type not included in the previously described categories established for the study).

Neurologic disease——For the purpose of analysis, definitive diagnoses of the neurologic diseases identified in horses in the ataxic group were categorized as congenital, CVCM, equine herpesvirus myeloencephalopathy, eNAD-EDM, EMND, EPM, hepatic encephalopathy (including pyrrolizidine alkaloid toxicoses), intervertebral disk disease, meningoencephalomyelitis, neoplasia, salt toxicoses, silicate-associated osteoporosis, vertebral subluxation, THO, trauma, West Nile virus infection, or other. If no definitive diagnosis was made, the neurologic disease was classified as ataxia of unknown origin. If results for a disease category included only 1 horse, the disease was classified as other. Descriptive results were reported for horses with neurologic disease categorized as trauma or neoplasia. Horses with CVCM were further grouped on the basis of whether their compressive lesion was type 1 (focal or multifocal and dynamic) or type 2 (remodeling of the articular process joints of the caudal cervical vertebrae with static stenosis) and on the basis of location (type 1, C1 through C6; type 2, C5 through T1).[13]

Statistical analysis

Contingency matrices and the Fisher exact test were used to compare results for horse breed or type category, sex, and age between the ataxic and control groups and within the ataxic group, with ORs and 95% CIs reported. Any horse without a breed or sex documented in its medical record was excluded from the corresponding analysis. For breed analysis, the 3 most common breed or type categories reported in the ataxic group were selected for comparisons of results across these breed or type categories with results for all other breeds combined. For analysis of age, results were compared for horses < 5 versus ≥ 5 years of age. This age limit was selected to have allowed horses to age to the point that many would have been started in training and neurologic deficits would have been observed. Within the ataxic group, results for horse breed or type category, age, and sex of horses grouped on the basis of the 4 most common postmortem diagnoses of the underlying cause of ataxia were compared with results for all other horses in the ataxic group. All statistical analyses were performed with available software.[a] Values of $P < 0.05$ were considered significant.

Results

Animals

A search of the medical records database identified 2,861 horses that met inclusion criteria for either the control group (n = 2,545) or ataxic group (316). For the control group, results for age had a bimodal distribution, and the mean age was 14.4 years (range, 12 hours to 40 years), with 494 horses < 5 years of age, 2,009 horses ≥ 5 years of age, and 42 horses with unknown age. For horses in the ataxic group, the mean age was 11.2 years (range, 20 days [an Arabian foal with occipitoatlantoaxial malformation] to 40 years [a Thoroughbred gelding with a vascular aneurysm]), with 107 horses < 5 years of age, 206 horses ≥ 5 years of age, and 3 horses with unknown age. The mean age was significantly ($P < 0.001$) younger for the ataxic group versus the control group, and the odds of having been < 5 years of age at euthanasia were significantly (OR, 2.11; 95% CI, 1.64 to 2.72; $P < 0.001$) higher for horses in the ataxic group (107/313 [34.2%]), compared with the control group (494/2,503 [19.7%]; Figure 1).

Sex was reported for all horses. Of the 2,545 horses in the control group, 1,128 were geldings, 243 were stallions, and 1,174 were mares. The control group had no obvious sex predisposition. Of the 316 horses in the ataxic group, 169 were geldings, 36 were stallions, and 111 were mares. Because of the low number of stallions in both groups, geldings and stallions were grouped together. The odds of being male were significantly higher (OR, 1.58; 95% CI, 1.24 to 2.02; $P < 0.001$) for horses in the ataxic group (205/316 [64.9%]) than in the control group (1,371/2,545 [53.9%]; Figure 1).

Breed or type of horse was reported for 2,541 horses in the control group, and the 3 most commonly reported breeds were AQH (671/2,541 [26.4%]), Thoroughbred (418/2,541 [16.5%]), and Arabian (315/2,541 [12.4%]; Figure 1). Breed or type of horse was reported for all 316 horses in the ataxic group, and the 3 most commonly reported were AQH (78/316 [24.7%]), warmblood (62/316 [19.6%]), and Thoroughbred (58/316 [18.4%]). Thus, further analyses by breed or type category were performed on the basis of horses grouped as AQH, Thoroughbred, warmblood, or other. Compared with horses in the control group, those in the ataxic group were more likely to have been warmblood horses (OR, 2.70; 95% CI, 1.97 to 3.68; $P < 0.001$) and less likely to have been Arabian horses (OR, 0.53; 95% CI, 0.34 to 0.83; $P = 0.004$).

Neurologic disease

A definitive diagnosis for the underlying causes of ataxia was determined for 260 horses, and 5 of those horses also had 2 concurrent neurologic diseases definitively diagnosed. The underlying causes of ataxia were not definitively diagnosed (thus recorded as ataxia of unknown origin) in the remaining 56 of 316 (17.7%) horses. For statistical analysis, horses with multiple causes of ataxia were counted in each of the diagnosed disease categories, yielding 321 diagnoses (265 definitive diagnoses and 56 recorded as ataxia of unknown origin) for ataxia in 316 horses. The 3 most common definitive diagnoses were CVCM (77/265 [29.1%]), eNAD-EDM (38/265 [14.3%]), and trauma (25/265 [9.4%]; Figure 2; Supplementary Figure S1, available at: avmajournals.avma.org/doi/suppl/10.2460/javma.258.12.1386). Interestingly, although horses with EMND typically have weakness and muscle trembling instead of ataxia, 2 horses with EMND were identified in the ataxic group and 1 of these horses also had eNAD-EDM. No horses were determined to have had cerebellar abiotrophy.

When these 4 most common diagnosis categories (CVCM, eNAD-EDM, trauma, or ataxia of unknown origin [no definitive diagnosis]) were considered for horses further grouped on the basis of breed or type category (AQH, warmblood, Thoroughbred, or other), horses with eNAD-EDM were 2.95 times as likely to have been AQHs (OR, 2.95; 95% CI, 1.46 to 5.93; $P = 0.004$) and nearly one-tenth as likely to have been Thoroughbreds (OR, 0.11; 95% CI, 0.01 to 0.80; $P = 0.006$; Figure 2). In contrast, horses with CVCM were more likely to have been Thoroughbreds (OR, 2.54; 95% CI, 1.38 to 4.66; $P = 0.004$) and less likely to have been breeds or types categorized as other (OR, 0.34; 95% CI, 0.19 to 0.63; $P < 0.001$). Horses with ataxia caused by trauma were more likely to have been breeds or types categorized as other (OR, 2.65; 95% CI, 1.15 to 6.10; $P = 0.03$). Furthermore, most horses with a traumatic cause of ataxia (15/25 [60%]) had a fracture involving their vertebral

column (11 [44%]) or skull (4 [16%]), whereas the remaining 10 (40%) horses had hemorrhage or hematoma within the vertebral column (8 [32%]) or skull (2 [8%]) and no evidence of fracture. The proportion of horses with ataxia of unknown origin was highest for horses in the breed or type category of other (20/56 [35.7%]), compared with warmblood (13/56 [23.2%]), Thoroughbred (13/56 [23.2%]), or AQH (10/56 [17.9%]). Despite the overrepresentation of warmblood horses in the ataxic group, compared with the control group, warmblood horses had no overt predisposition for a particular underlying cause of ataxia.

When the top 4 most common diagnoses were compared for horses grouped on the basis of sex or age (< 5 vs ≥ 5 years of age), no meaningful difference was identified for sex; however, horses < 5 (vs ≥ 5) years of age were significantly ($P < 0.001$) more likely to have had eNAD-EDM (OR, 6.17; 95% CI, 2.92 to 13.02) or CVCM (OR, 2.82; 95% CI, 1.66 to 4.79), compared with all causes of ataxia (Figure 2). In addition, age may have been associated with the ataxia diagnosis categories of neoplasia and THO because only 1 of the 22 horses with ataxia attributed to neoplasia was < 5 years of age, and all 20 of the horses with THO were ≥ 5 years of age. Of the 22 horses with neoplasia, 9 had lymphoma, 2 had hemangiosarcoma, 2 had melanoma, and the remaining 9 each had various other neoplasms (Supplementary Table S1, available at: avmajournals.avma.org/doi/suppl/10.2460/javma.258.12.1386).

Of the 77 horses with CVCM, 36 (47%) had type 1 CVCM and 28 (36%) had type 2 CVCM (Table 1). The type of CVCM in the remaining 13 (17%) horses could not be definitively classified because their lesions had characteristics that overlapped types 1 and 2 (eg, findings of axonal degeneration that extended the entire length of the cervical portion of the spinal cord and dynamic compression combined with articular facet remodeling of the caudal cervical vertebrae and associated static compression). The mean ± SD age was younger for horses with CVCM type 1 (5.4 ± 5.4 years) versus type 2 (9.1 ± 6.7 years), with AQHs and warmbloods, respectively, affected most commonly.

When results of necropsy for horses in the ataxic group were assessed over the duration of the study period, eNAD-EDM was noticed not to have been diagnosed at the UCD VMTH until 2008 (Figure 3). Additionally, although the overall number of horses with ataxia of unknown origin varied from year to year, the number of such was lower in the last 3 years of the study period, which was the same time span when the diagnosis of eNAD-EDM was more common. Necropsies of horses with ataxia comprised approximately 11.0% (316/2,861) of all necropsies performed on horses at the UCD VMTH during the study period. When the yearly numbers of necropsies performed on horses with and without ataxia were considered, we noticed that, despite fewer necropsies on horses with ataxia in 2012 (13/192 [6.8%]) and 2014 (17/198 [8.6%]), there was relatively no change in the overall number of necropsies performed on horses during those years. The total number of necropsies peformed on horses per year was > 240 for the first 4 years of the study period and ranged between 188 and 222 for the remaining years. Overall during the study period, the period prevalence was 2.7% (77/2,861) for CVCM, 2.0% (56/2,861) for ataxia of unknown origin, 1.3% (38/2,861) for eNAD-EDM, and 0.9% (25/2,861) for trauma-induced ataxia.

Discussion

The purpose of the present study was to assess the period prevalences of underlying causes of spinal ataxia in horses euthanized and necropsied at the UCD VMTH between January 1, 2005, and December 31, 2017. Our findings that the 3 most common definitive diagnoses for ataxia in horses were CVCM, eNAD-EDM, and trauma supported our hypothesis that CVCM and eNAD-EDM were leading causes of ataxia in horses of the present study. However, we also recognize that 17.4% (56/321) of the horses had ataxia of unknown origin (no definitive diagnosis), which was the second most common outcome overall. To our knowledge, this type of study had not been performed since 1989,12 and pathological causes of ataxia in horses have not been previously investigated in the western United States. Our findings were consistent with findings of CVCM and eNAD-EDM as the leading causes of spinal ataxia reported for horses in the eastern United States.[11,12]

In contrast to previous studies,[11,12] EPM was not a leading cause of ataxia in horses of the present study, and the reason for such was unknown. Contributing factors may have included differences related to geographic regions, presence of definitive and intermediary hosts, husbandry practices, and therapeutic management of horses in which EPM was diagnosed or suspected. Additionally, 3 decades separated the present study from those earlier studies, [11,12] and some variation in incidence owing to naturally occurring temporal fluctuations may have also contributed to the differences. Further evaluation of medical records and husbandry practices may help determine why EPM was diagnosed less commonly in ataxic horses of the present study.

Our findings indicated that the ataxic group (vs the control group) had a disproportionately high representation of warmblood horses and a disproportionately low representation of Arabian horses. Because warmblood horses (vs various other breed or type categories) have been shown to have higher odds of CVCM[14] and because CVCM was the most common diagnosis in the ataxic group of the present study, we were not surprised by the overrepresentation of warmbloods in the ataxic group. As for Arabian horses, we suspect that their underrepresentation could have been due to a low frequency of clinically observed disease or a lack of referral from the surrounding veterinary clinics. Additionally, our finding that none of the ataxic horses had cerebellar abiotrophy suggested that genetic testing[15] and breeder education may have contributed to the absence of the disease in horses of the present study.

Results indicated associations between underlying causes of ataxia and horse breed or type. For instance, horses with eNAD-EDM were 2.95 times as likely to have been AQHs, a breed known to have breed-specific diseases such as hyperkalemic periodic paralysis, hereditary regional dermal asthenia, glycogen branching enzyme deficiency, type 1 polysaccharide storage myopathy, and malignant hyperthermia. However, despite strong evidence for an inherited basis to eNAD-EDM,[16–18] a breed predisposition to eNAD-EDM had not been reported before the present study. In addition, Thoroughbreds were less likely to have had eNAD-EDM (OR, 0.11) and more likely to have had CVCM (OR, 2.54) in the present study. Further, CVCM was identified less commonly in horses categorized as other (breeds other than AQHs, warmbloods, and Thoroughbreds).

Consistent with previous reports,[13,19] horses of the present study with CVCM type 1 were generally younger than those with CVCM type 2. In addition, warmblood horses were more commonly affected with CVCM type 2, whereas AQHs were more commonly affected with type 1. In contrast to previous studies,[14,19] our findings did not indicate a predisposition for CVCM in males. Despite this result, there were more male horses identified with each type of CVCM in the present study, and the lack of an association identified between sex and CVCM was possibly due to overrepresentation of males in the ataxic group, confounding any discrepancies in sex distribution among disease categories. Nonetheless, sex discrepancy in horses with CVCM continues to be an active topic of research.[14,20,21]

Both CVCM and eNAD-EDM have been identified previously as diseases that are diagnosed early in the lives of horses.[10,14] In the present study, CVCM and eNAD-EDM were identified more commonly in younger horses (< 5 years of age; OR, 2.82 and 6.17, respectively). Additionally, THO and neoplasia were found almost exclusively in older horses (≥ 5 years of age). Similar patterns have been seen in the development of arthritic diseases[22] and neoplasia[23,24] in humans.

Over the study period, the 3 years during which eNAD-EDM was definitively diagnosed (2015 through 2017) in the highest numbers of horses were the same years when ataxia of unknown origin was diagnosed least. This also coincided with the time frame when researchers began studying these neurologic diseases at the UCD VMTH and recruiting ataxic horses for research purposes. Thus, such recruitment of horses with eNAD-EDM was a confounding variable in the present study.

Ease of access to necropsy without owner fees could have also biased the present study. However, UCD VMTH policy during the study period was that horses examined at the hospital that subsequently died or were euthanized were eligible for a full postmortem evaluation at no additional cost. Relatedly, our findings indicated that fewer necropsies of horses with ataxia were performed in 2012 and 2014, with no clear cause.

Another limitation of the present study was that although we were most interested in spinal ataxia, our use of the search term *atax** did not distinguish between spinal, cerebellar, and vestibular ataxia. However, clinical signs of THO,[25] hepatic encephalopathy,[26] and EMND[27] do not include spinal ataxia. For instance, horses with THO typically have vestibular ataxia, not spinal ataxia. Additionally, hepatic encephalopathy is differentiated from other forms of ataxia on the basis of clinical signs indicating cerebral involvement, such as liver dysfunction, behavioral changes, and signs of mentation changes. Horses with EMND typically have weakness and muscle trembling instead of ataxia; however, 2 horses with EMND were identified in the present study.

The outcomes of the present study were limited to the UCD VMTH. However, because our findings were consistent with 2 previous studies[11,12] and indicated that CVCM and eNAD-EDM were among the top 3 causes of ataxia in horses, we concluded that these 2 disease categories are among the top 3 causes of ataxia in horses at veterinary teaching hospitals across North America. We acknowledge that the cost of disposal alleviation offered to owners of ataxic horses for research purposes could have inflated disease prevalence of

eNAD-EDM within the last 3 years of the present study. Additionally, each horse did not have multiple sections of the spinal cord examined; rather, priorities for sections examined were assigned on the basis of gross necropsy findings. This could have contributed to the number of horses with an underlying cause of ataxia not definitively diagnosed. Future work could include a prospective study that focuses on breed and sex differences in ataxic horses that are euthanized and undergo necropsy with rapid collection of neural tissues for evaluations.

In conclusion, to our knowledge, the present study was the first to examine the underlying pathological causes of ataxia in a large group of horses since 1989 and the first of such that included horses of the western United States. In horses of the present study, the top definitive diagnoses for ataxia were CVCM, eNAD-EDM, and trauma. These findings were consistent with previous studies[11,12] that indicate CVCM and eNAD-EDM are among the top 3 causes of ataxia. In addition, our results indicated that breed distributions differed for horses with CVCM versus eNAD-EDM; therefore, breed should be considered in the clinical evaluation of ataxia in horses.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

AQH	American Quarter Horse
CVCM	Cervical vertebral compressive myelopathy
EMND	Equine motor neuron disease
eNAD-EDM	Equine neuroaxonal dystrophy or equine degenerative myeloencephalopathy
EPM	Equine protozoal myeloencephalitis
THO	Temporohyoid osteoarthropathy
UCD VMTH	University of California-Davis Veterinary Medical Teaching Hospital

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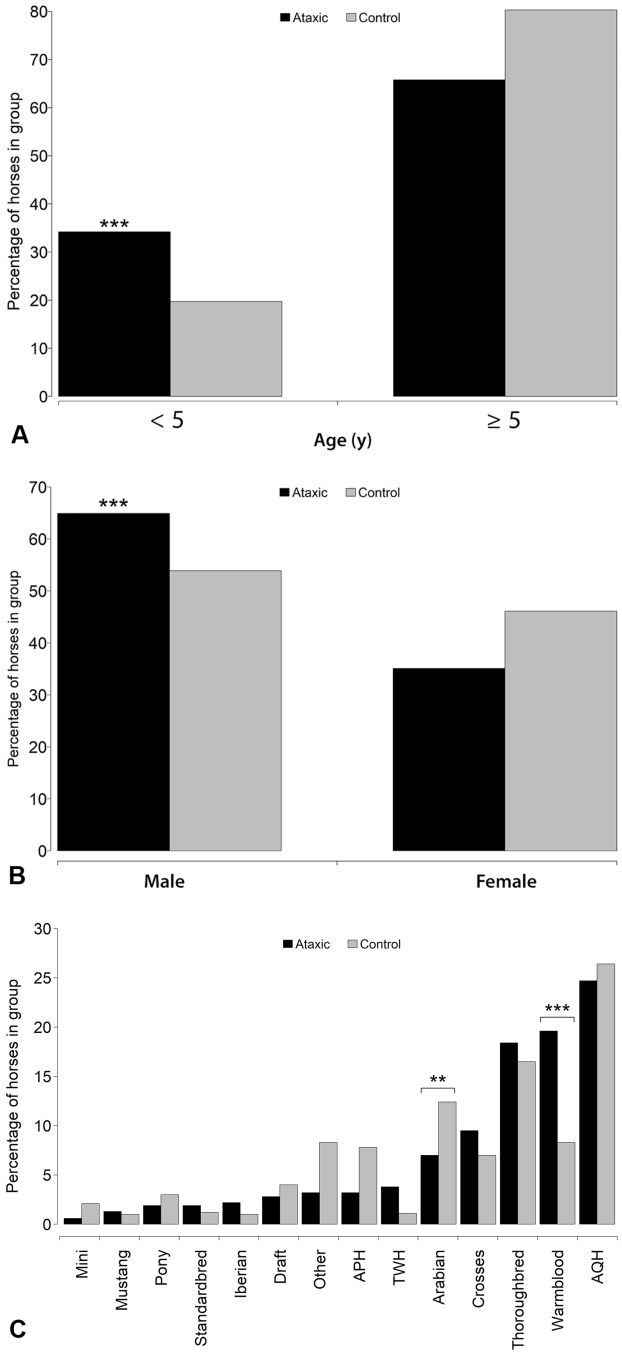

Figure 1—.

Frequency distributions of age (A), sex (B), and breed or type categories (C) for 2,861 client-owned horses (316 with spinal ataxia [ataxic group; black shading] and 2,545 without spinal ataxia [control group; gray shading]) that underwent necropsy (including full gross and histologic evaluations of neural tissues) at the UCD VMTH between January 1, 2005, and December 31, 2017. Compared with the control group, horses in the ataxic group had greater odds of having been < 5 years of age at euthanasia (OR, 2.11), male (OR, 1.58), or warmbloods (OR, 2.70) and lower odds of having been Arabian horses (OR, 0.53).

Significant ($P < 0.01$ [double asterisk] and $P < 0.001$ [triple asterisks]) differences in results for the ataxic group versus the control group are noted. APH = American Paint Horse. Mini = Miniature horse. TWH = Tennessee Walking Horse.

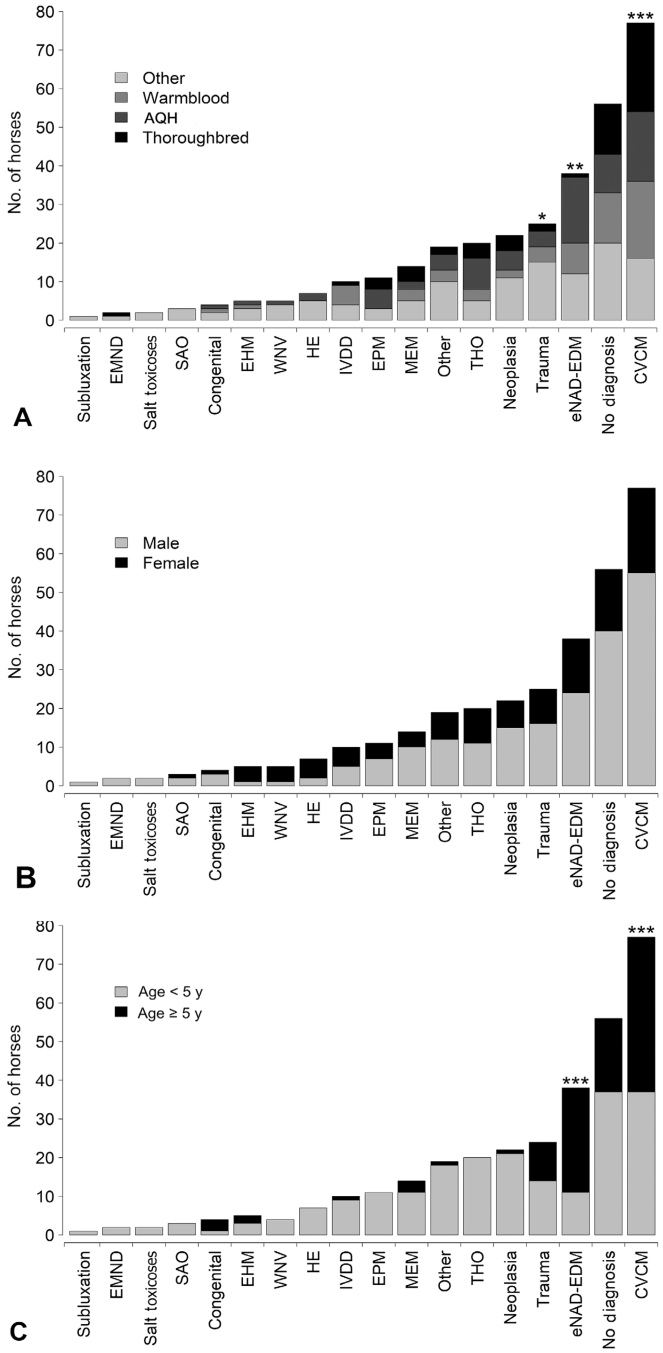

Figure 2—.

Frequency distribution of diagnoses of underlying causes of ataxia in horses of the ataxic group described in Figure 1 when further grouped on the basis of horse breed or type category (AQH, warmblood, Thoroughbred, or other [A]), sex (B), or age (< 5 vs ≥ 5 years of age [C]). Horses with CVCM were more likely Thoroughbreds (OR, 2.54) and less likely breeds or types categorized as other (OR, 0.34). Horses with eNAD-EDM were more likely AQHs (OR, 2.95) and less likely Thoroughbreds (OR, 0.11). Horses with ataxia caused by trauma were more likely breeds or types categorized as other (OR, 2.65). Horses < 5 (vs ≥ 5)

years of age had greater odds of eNAD-EDM (OR, 6.17) or CVCM (OR, 2.82) than other causes of ataxia. Significant ($P < 0.05$ [asterisk], $P < 0.01$ [double asterisks], and $P < 0.001$ [triple asterisks]) differences in diagnosis results for horses grouped on the basis of signalment variable of interest are noted. EHM = Equine herpesvirus myeloencephalopathy. HE = Hepatic encephalopathy. IVDD = Intervertebral disk disease. MEM = Meningoencephalomyelitis. SAO = Silicate-associated osteoporosis.

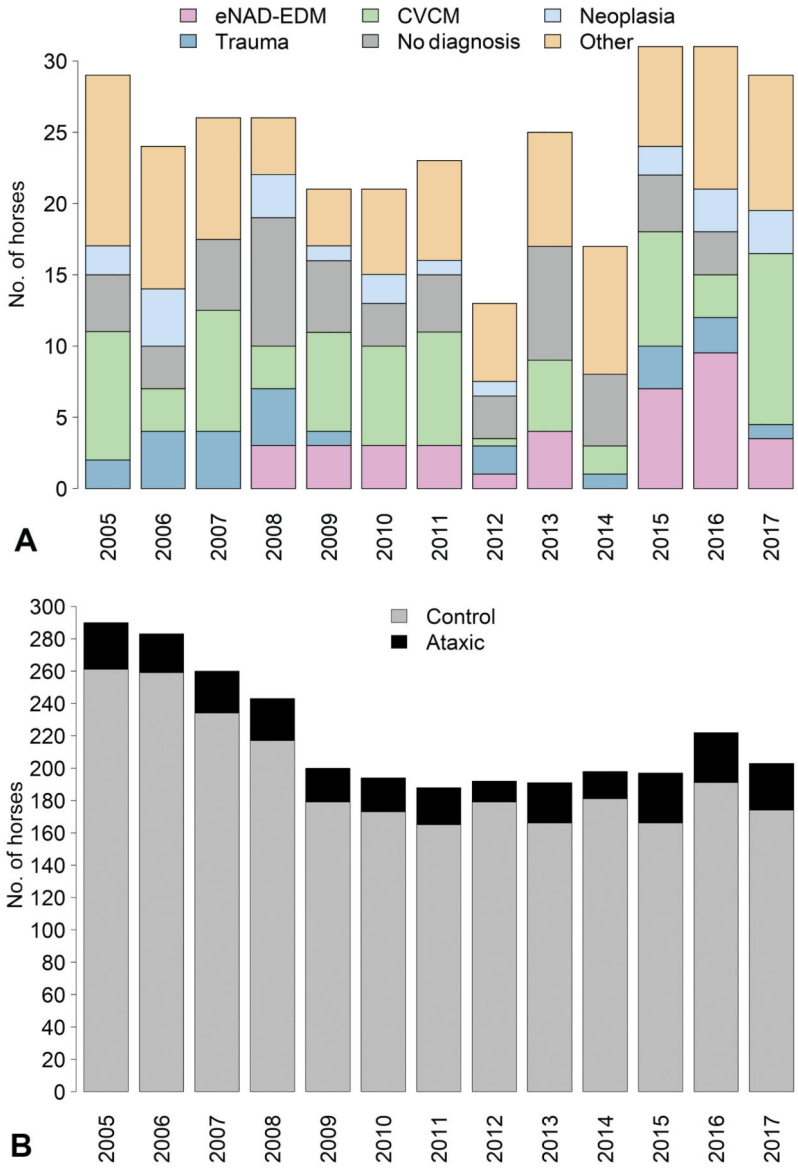

Figure 3—.

Frequency distribution by year of necropsy for the postmortem diagnoses of underlying causes of spinal ataxia (categorized as eNAD-EDM, trauma, CVCM, no diagnosis, neoplasia, or other) in horses of the ataxic group (A) and the overall numbers of horses necropsied each year for the ataxic (black; n = 316) versus control (gray; 2,545) groups (B) described in Figure 1.

Table 1—

Summary results for age, sex, and breed or type category of 77 ataxic horses with CVCM definitively diagnosed postmortem at the UCD VMTH between January 1, 2005, and December 31, 2017, stratified by CVCM type (1 [n = 36], 2 [28], or overlapping characteristics consistent with types 1 and 2 [13]).

		Age (y)		Sex		
CVCM type	**No. (%) of horses**	**Mean ± SD**	**Range**	**No. of males**	**No. of females**	**Breed or type (No. of horses)**
1	36 (47%)	5.4 ± 5.4	0.7–13	25	11	AQH (14) Thoroughbred (11) Warmblood (5) Other (3) Draft (2) TWH (1)
2	28 (36%)	9.1 ± 6.7	1–31	20	8	Warmblood (12) Thoroughbred (9) AQH (3) Arabian (2) Other (2)
Overlapping	13 (17%)	5.5 ± 5.17	0.2–19	10	3	Warmblood (4) Thoroughbred (3) Draft (2) Other (2) Pony (1) AQH (1)

TWH = Tennessee Walking Horse.