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1 **Clinical reasoning in feline spinal disease: which combination of clinical**  
2 **information is useful?**

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20 **Keywords:**

21 spinal disorder; neurology; intervertebral disc disease; spinal lymphoma; feline

22 infectious peritonitis

23

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25 The results of this study have been presented in abstract form (poster presentation) for

26 the 31<sup>st</sup> symposium of the European society of veterinary neurology - European

27 college of veterinary neurology (ESVN-ECVN), 20-22 September 2018, Copenhagen,

28 Denmark

## 29 **Abstract**

30 *Objectives:* To evaluate if a combination of discrete clinical characteristics can be  
31 used to identify the most likely differential diagnoses in cats with spinal disease.

32 *Methods:* 221 cats referred for further evaluation of spinal disease were included and  
33 categorised into the following disease categories: non-lymphoid neoplasia (n=44),  
34 intervertebral disc disease (n=42), fracture/luxation (n=34), ischaemic myelopathy  
35 (n=22), feline infectious peritonitis virus myelitis (n=18), lymphoma (n=16), thoracic  
36 vertebral canal stenosis (n=11), acute non-compressive nucleus pulposus extrusion  
37 (n=11), traumatic spinal cord contusion (n=8), spinal arachnoid diverticula (n=7),  
38 lumbosacral stenosis (n=5) and spinal empyema (n=3). Information retrieved from the  
39 medical records included signalment, clinical history and clinical presentation.

40 Univariate analyses of variables (clinical history, breed, age, gender, general physical  
41 examination findings, onset, progression, spinal hyperaesthesia, asymmetry,  
42 ambulatory status and neuroanatomical localisation) were performed, and variables  
43 were retained in a multivariate logistic regression model if  $P < 0.05$ .

44 *Results:* Multivariate logistic regression revealed that intervertebral disc disease most  
45 often occurs in middle-aged, purebred cats with a normal general physical  
46 examination and an acute onset of painful and progressive clinical signs. Ischaemic  
47 myelopathy occurs most often in older cats with a stable or improving, non-painful,  
48 lateralising, C6-T2 myelopathy. Spinal fracture/luxation occurs most often in younger  
49 cats and results most often in a peracute onset, painful, non-ambulatory neurological  
50 status. Concurrent systemic abnormalities or abnormal findings detected on general  
51 physical examination was significantly associated with feline infectious peritonitis  
52 virus myelitis, spinal lymphoma or spinal empyema.

53 *Conclusions and relevance:* This study suggests that using easily identifiable  
54 characteristics from the history and clinical examination can assist in obtaining a  
55 preliminary differential diagnosis when evaluating cats with spinal disease. This  
56 information could aid veterinary practioners in clinical decision making.

57

58

## 59 **Introduction**

60 Assessment of cats with suspected spinal disease can be daunting for veterinary  
61 practitioners. Neurophobia is the fear of neuroscience and clinical neurology which  
62 was first recognised in medical students and young physicians.<sup>1</sup> It is associated with  
63 the belief that neurology is a complex subject that is academically challenging and  
64 difficult to apply in clinical practice. It results in decreased confidence and the  
65 inability to apply basic knowledge into clinical practice, essentially leading to  
66 paralysis of analysis or ‘paralysis of thinking’.<sup>1-3</sup> Following a surge in veterinary  
67 neurology research in the last 15 years, neurological diseases are more frequently  
68 recognised. Despite the accompanying rise in understanding of neurological disorders,  
69 the ‘neurophobia’ phenomenon remains prevalent particularly among young  
70 veterinarians.<sup>4,5</sup>

71 A variety of spinal disorders has been recognised in cats, which are associated with  
72 different diagnostic approaches, treatment options and varying prognoses.<sup>6-8</sup>  
73 Infectious disorders, specifically feline infectious peritonitis (FIP) virus myelitis, has  
74 historically been considered the most common feline spinal disorder, followed by  
75 neoplastic disease, primarily lymphoma.<sup>6,8</sup> Other commonly diagnosed feline spinal  
76 disorders are spinal fracture and luxation, intervertebral disc disease and ischaemic  
77 myelopathy.<sup>6-8</sup> With such an extensive list of differential diagnoses, it is not  
78 surprising that cats with spinal disease are commonly referred to neurology  
79 specialists. Advanced diagnostic tests commonly performed in the referral setting,  
80 such as magnetic resonance imaging (MRI) and cerebrospinal fluid (CSF) collection,  
81 can however be invasive and financially prohibitive.<sup>9</sup> Furthermore, not all cat owners  
82 will be able or prepared to accept referral to neurology specialists. It is therefore  
83 necessary for veterinarians to apply their knowledge and clinical reasoning skills to

84 obtain a likely diagnosis and subsequently consider the necessity, specific advantages,  
85 expectations and limitations of a potential referral to a specialist referral centre.

86 By considering the signalment, obtaining a thorough clinical history, performing a  
87 general physical examination, a complete neurological examination and obtaining a  
88 neuro-anatomical localisation it is possible to identify key factors that can be vital in  
89 clinical decision making.<sup>9-11</sup> It has been identified that most canine spinal diseases are  
90 statistically associated with distinct characteristic combinations of clinical variables.<sup>9</sup>  
91 It is currently however unknown if such a statistical model could also be used to guide  
92 a clinical reasoning approach in feline spinal disease. The aim of this study was  
93 therefore to evaluate if discrete clinical characteristics, such as clinical history,  
94 general physical examination findings, signalment, onset, progression, symmetry of  
95 clinical signs, spinal hyperaesthesia, ambulatory status, and neuro-anatomical  
96 localisation can be used to statistically predict the most likely differential diagnoses in  
97 cats with spinal disease. We hypothesised that statistical models could be used to  
98 identify associations between the most common feline spinal disorders and specific  
99 combinations of clinical variables. This information could aid in determining the most  
100 likely differential diagnoses when assessing cats with spinal disease and hence  
101 improve clinical decision making for veterinary practitioners.

102

### 103 **Materials and Methods**

104

105 This retrospective study was approved by the ethics and welfare committee of the  
106 Royal Veterinary College (RVC, SR2018-1663). The digital medical database of the  
107 small animal referral hospital, RVC was searched for all records of cats referred for

108 further evaluation of suspected spinal disease between 2 August 2007 and 3 January  
109 2018. Cats were included if they underwent a complete neurological examination and  
110 appropriate further diagnostics to obtain a definitive or presumptive diagnosis of an  
111 underlying spinal condition. Further diagnostics could include one or a combination  
112 of the following; spinal radiographs, computed tomography (CT), MRI, CSF analysis,  
113 infectious disease testing, cytology or histopathology. Cats with sacrocaudal luxation  
114 were not included in this study. Cats were excluded if the medical records or imaging  
115 studies were incomplete or not available for review or if a final clinical or  
116 presumptive diagnosis was not reached. Although cats were only included if they  
117 presented for further evaluation of spinal disease, they were not excluded if the  
118 neurological examination revealed abnormalities suggestive for intracranial  
119 involvement. All medical records and imaging studies were reviewed by a board-  
120 certified neurologist (SDD) and cats were allocated to one of the following 12 disease  
121 categories: presumptive non-lymphoid spinal neoplasia, degenerative intervertebral  
122 disc disease, spinal fracture/luxation, ischaemic myelopathy, FIP virus myelitis, spinal  
123 lymphoma, thoracic vertebral canal stenosis, traumatic spinal cord contusion, spinal  
124 arachnoid diverticula, lumbosacral stenosis, and spinal empyema. Cases were grouped  
125 into a disease category when a diagnosis was made in more than two cats. Cats that  
126 suffered from spinal conditions that were made only once or twice in the study period  
127 were therefore not included in this study. For the purpose of this study, a diagnosis of  
128 FIP was made when a diagnosis was confirmed by histopathology or detection of  
129 feline coronavirus in CSF by real-time reverse transcriptase polymerase chain  
130 reaction (real-time RT-PCR).<sup>12,13</sup> A diagnosis of lymphoma was made when a  
131 histopathological diagnosis was made or when MRI was suggestive for a neoplastic  
132 spinal condition and cytological evaluation of CSF or extraneural tissue was



133 suggestive for lymphoma.<sup>14</sup> A diagnosis of presumptive non-lymphoid spinal  
134 neoplasia was made when neoplastic disease other than lymphoma was  
135 histopathologically confirmed or if cytological evaluation of CSF or extraneural  
136 tissues did not reveal any indications for lymphoma. A diagnosis of thoracic vertebral  
137 canal stenosis was defined as a focal osseous vertebral canal stenosis. Diagnostic  
138 criteria for the other spinal disease categories were based on previously published  
139 literature.<sup>15-23</sup>

140 For all included cases, the following information was retrieved from the medical  
141 records: clinical history with emphasis on the occurrence of other clinical signs such  
142 as lethargy, anorexia and weight loss; signalment; onset; duration; type; and severity  
143 of clinical signs; general physical and neurological examination findings, including  
144 lateralisation of clinical signs and presence of spinal hyperaesthesia. Age was  
145 classified as younger (<3 years), middle aged (3–9 years), and older (>9 years). Onset  
146 of clinical signs was categorised into peracute (<2 days), acute (2-5 days), subacute  
147 (5-14 days) and chronic (>14 days). Progression of clinical signs was categorised into  
148 deteriorating, static or improving clinical signs before presentation at the RVC. This  
149 assessment was based on the notes from the referring veterinary surgeon and owner's  
150 perception. Severity of clinical signs was categorised into ambulatory or non-  
151 ambulatory neurological status on presentation. Spinal hyperaesthesia was considered  
152 to be present when a painful response could be elicited on spinal palpation by the  
153 attending clinician or when obvious spinal pain was reported by the referring  
154 veterinary surgeon or owner of the cat. Neurological signs were considered to be  
155 lateralised when there was an unequivocal difference in the severity of neurological  
156 deficits between the left and right side of the cat. The neuro-anatomical localisation

157 was categorised into disorders affecting the C1-C5, C6-T2, T3-L3 or L4-S3 spinal  
158 cord segments or multifocal with intracranial involvement.

159 Computed tomography was performed with a 16-slice helical CT scanner (PQ 500,  
160 Universal Systems, Solon; GE Healthcare), under sedation or general anaesthesia.  
161 After completion of the transverse CT study, sagittal, dorsal and 3-dimensional  
162 reconstructions were made. Magnetic resonance imaging was performed under  
163 general anaesthesia with a high-field unit (1.5T, Intera, Philips Medical Systems) and  
164 imaging studies included a minimum of T1- and T2-weighted sagittal and transverse  
165 images.

166 Statistical analysis was performed by one of the authors (TJC) and data were analyzed  
167 using statistical software (SPSS; Statistical Package for the Social Sciences V.21.0.1).

168 Univariate analyses of potential explanatory variables for each condition were  
169 performed. Variables were considered for inclusion in multivariate logistic regression  
170 if  $P < 0.30$  and retained in the final model if  $P < 0.05$ , based on the likelihood ratio test.  
171 Multivariate logistic regression was carried out using a forced entry method (where  
172 all variables are entered into the equation in a single step) to examine associations  
173 between included variables with a significance level of  $P < 0.05$ .<sup>24</sup> Results are  
174 presented with odds ratios (OR) and 95 per cent confidence intervals (CI) for each  
175 condition versus the overall spinal disease population.<sup>24</sup> Following multivariate  
176 logistic regression for each disease variables retained in the final model ( $P < 0.05$ )  
177 included: purebred status, age (signalment), concurrent abnormalities in the clinical  
178 history or general physical examination, median time to presentation, progression of  
179 clinical signs, ambulatory status, spinal hyperaesthesia, asymmetry in neurological  
180 deficits and neuroanatomical localisation. Non-normally distributed data were

181 presented as median value with the range. Normally distributed data were presented  
182 as means and standard deviation (sd) (means±sd).

183

## 184 **Results**

185 Two-hundred and twenty-six cats were diagnosed with a spinal condition in the study  
186 period. Five cats were excluded because their diagnosis occurred only once or twice.  
187 These five cats were diagnosed with traumatic intramedullary haemorrhage (n=2  
188 cats), suspected poliomyelitis, Toxoplasmosis and vertebral malformation caused by  
189 mucopolysaccharidosis (n= 1 cat for each diagnosis).

190 Two-hundred and twenty-one cats were therefore included in this study. This group  
191 consisted of 143 males (131 neutered) and 78 females (67 neutered) between two  
192 months and 18 years of age. The most commonly diagnosed condition was  
193 presumptive non-lymphoid neoplasia (n=44 cats; 19.9% of cats), followed by  
194 degenerative intervertebral disc disease (42 cats; 19%), spinal fracture and luxation  
195 (34 cats; 15.4%), ischaemic myelopathy (22 cats; 10%), FIP virus myelitis (18 cats;  
196 8.1%), lymphoma (16 cats; 7.2%), thoracic vertebral canal stenosis (11 cats; 5.0%),  
197 acute non compressive nucleus pulposus extrusion (11 cats; 5.0%), traumatic spinal  
198 cord contusion (8 cats; 3.6%), spinal arachnoid diverticulum (7 cats; 3.2%),  
199 lumbosacral stenosis (5 cats; 2.3%) and spinal empyema (3 cats; 1.4%). A summary  
200 of the clinical presentation of cats affected by these disorders is presented in Table 1.

201 The 44 cats with presumptive non-lymphoid neoplasia included 15 cats with contrast  
202 enhancing intramedullary mass lesions. Serum Toxoplasma titers were negative and  
203 CSF analysis was within normal limits in all these 15 cats. Thirteen cats had vertebral  
204 masses of which five were histopathologically confirmed to be osteosarcoma and one

205 was confirmed to be a plasmacytoma, six cats had histopathologically confirmed  
206 meningioma, two cats histopathologically confirmed glial cell tumors, two had  
207 unspecified extradural mass lesions, and each of the following diagnoses were made  
208 in one cat: vascular hamartoma, fibrosarcoma, solitary giant cell tumor of soft tissue,  
209 histiocytic sarcoma, peripheral nerve sheath tumor, and metastatic neoplasia.

210

### 211 **Age**

212 Older age was associated with a diagnosis of presumptive non-lymphoid neoplasia,  
213 ischaemic myelopathy, and lumbosacral stenosis (Table 2). Cats with degenerative  
214 intervertebral disk disease were more likely middle aged and cats with spinal fracture  
215 and luxation, FIP virus myelitis, and traumatic spinal cord contusion were more likely  
216 younger (Table 2).

217

### 218 **Breed**

219 33% of cats in this study were purebred (n=55) and 67% were non-purebred (n=166).  
220 The group of non-purebred cats consisted of domestic shorthair (n=143 cats),  
221 domestic longhair (n=19) and domestic medium hair cats (n=4). The most common  
222 purebred cat was the British shorthair (n= 11), followed by the Bengal (n=9), Persian  
223 (n=8), Maine Coon (n=7), Sphinx and Siamese (n=3 for both), Russian Blue,  
224 Chinchilla, Tonkinese and Ragdoll (n=2) and six breeds were represented by only one  
225 cat. Purebred status was significantly associated with a diagnosis of presumptive non-  
226 lymphoid neoplasia, degenerative intervertebral disc disease and thoracic vertebral  
227 canal stenosis. Cats with degenerative intervertebral disc disease and thoracic

228 vertebral canal stenosis were more likely purebred cats, while cats with presumptive  
229 non-lymphoid neoplasia were more likely non-purebred cats (Table 2).

230

### 231 **Concurrent clinical signs and general physical examination findings**

232 Compared to other diagnoses, cats with FIP virus myelitis, lymphoma and spinal  
233 empyema had more often concurrent clinical signs, such as lethargy, anorexia and  
234 weight loss, or abnormalities on their general physical examination, such as pyrexia  
235 and lymphadenomegaly. Cats with degenerative intervertebral disk disease had  
236 significantly less often concurrent clinical signs or abnormalities on their general  
237 physical examination (Table 2).

238

### 239 **Onset and progression of clinical signs**

240 Onset of disease was significantly associated with diagnoses of degenerative  
241 intervertebral disk disease and vertebral fracture and luxation. Cats with degenerative  
242 intervertebral disk disease had more likely an acute onset of clinical signs, while cats  
243 with vertebral fracture and luxation had more likely a peracute onset of clinical signs  
244 (Table 2). Progression of clinical signs was significantly associated with diagnoses of  
245 presumptive non-lymphoid neoplasia, degenerative intervertebral disc disease and  
246 ischaemic myelopathy. Cats with presumptive non-lymphoid neoplasia and  
247 degenerative intervertebral disc disease had more likely deteriorating clinical signs,  
248 while cats with ischaemic myelopathy demonstrated more likely static or improving  
249 clinical signs (Table 2).

250

251 **Neurological examination findings**

252 *Neuro-anatomical localisation*

253 The neuro-anatomical localisation was significantly associated with diagnoses of  
254 ischaemic myelopathy and FIP virus myelitis. Cats with ischaemic myelopathy had  
255 more likely a lesion localised to the C6-T2 spinal cord segments, while cats with FIP  
256 virus myelitis had more likely a multifocal neuro-anatomical localisation with  
257 intracranial involvement (Table 2).

258

259 *Ambulatory status*

260 Ambulatory status was significantly associated with diagnoses of spinal fracture and  
261 luxation and acute non-compressive nucleus extrusion. Cats with spinal fracture and  
262 luxation or acute non-compressive nucleus pulposus extrusion were more likely not  
263 ambulatory at the time of presentation (Table 2).

264

265 *Presence of spinal hyperaesthesia*

266 Presence of spinal hyperaesthesia was significantly associated with diagnoses of  
267 degenerative intervertebral disk disease, spinal fracture and luxation, ischaemic  
268 myelopathy and thoracic vertebral canal stenosis. Cats with degenerative  
269 intervertebral disk disease, spinal fracture and luxation, and thoracic vertebral canal  
270 stenosis demonstrated more likely spinal hyperaesthesia, while cats with ischaemic  
271 myelopathy demonstrated less likely spinal hyperaesthesia (Table 2).

272

### 273 *Lateralisation of clinical signs*

274 Presence of obviously lateralised clinical signs was significantly associated with  
275 diagnoses of ischaemic myelopathy and thoracic vertebral canal stenosis. Cats with  
276 ischaemic myelopathy and thoracic vertebral canal stenosis were more likely to  
277 demonstrate lateralisation of their clinical signs (Table 2).

278

### 279 **Discussion**

280 This study evaluated if discrete clinical characteristics can be used to aid in  
281 identifying the most likely differential diagnoses in cats with spinal disease. Our  
282 results suggest that the most common feline spinal disorders are statistically  
283 associated with discrete variables obtained from the clinical history, signalment, and  
284 general physical and neurological examinations. Due to the extensive list of possible  
285 diagnoses and the associated variation in prognoses of cats with spinal disease,  
286 achieving a ‘most likely’ differential diagnosis before carrying out further diagnostics  
287 is invaluable, particularly in the first opinion setting where finances can be a major  
288 concern. In agreement with our findings, previous studies evaluating canine spinal  
289 disease and canine and feline epilepsy highlighted how problem-based clinical  
290 reasoning enabled a diagnostic process which was focused at the level of the  
291 signalment, history, clinical signs, and neurological examination.<sup>9-11</sup> Clinical  
292 reasoning can be considered a thinking process in which we collect and process  
293 multiple fragments of clinical information, come to an understanding of a patient’s  
294 clinical problem, and use this integrated information to plan further diagnostic and  
295 therapeutic interventions. Following this approach can help breaking down complex  
296 and potentially overwhelming clinical presentations into logical and manageable

297 cases.<sup>25</sup> We therefore hope that the results of this study will improve clinical decision  
298 making for veterinary surgeons managing cats with spinal disease.

299 The most common feline spinal disorders in this study were presumptive non-  
300 lymphoid neoplasia, followed by intervertebral disc disease, fracture and luxation, and  
301 ischaemic myelopathy. Feline infectious peritonitis virus myelitis was only the fifth  
302 most common spinal disorder. This finding is different from previous data suggesting  
303 that FIP virus myelitis should be considered the most common spinal disorder in  
304 cats.<sup>6,8</sup> This difference can potentially be explained by geographical differences in the  
305 prevalence of spinal disorders and infectious diseases in particular. Another  
306 contributing factor could be the different inclusion criteria used in studies. A previous  
307 study evaluating the prevalence of spinal disorders in cats included cases for which a  
308 histopathological diagnosis was available.<sup>6</sup> Although this inclusion criterion has the  
309 clear advantage that only cases with a definitive diagnosis were included, a  
310 histopathological diagnosis is typically only obtained after completion of a necropsy.  
311 This inclusion criterion could therefore potentially favour the selection of cases with a  
312 poor prognosis, such as FIP virus myelitis and spinal neoplasia. It should further be  
313 emphasised that our study only included cats that presented for further evaluation of  
314 spinal disease. Although we did not exclude cases for which the neurological  
315 examination revealed abnormalities suggestive for intracranial involvement, we did  
316 not include cats for which spinal disease was part of a more complex and multifocal  
317 neurological presentation. Although it is possible that our study therefore represents a  
318 more accurate reflection of the prevalence of feline spinal disorders in a referral  
319 clinical setting, a major limitation is the lack of a definitive diagnosis in several cases.  
320 This is especially true for the group of non-lymphoid spinal tumors, which was



321 considered the most common diagnosis in our study. This diagnosis was more  
322 common in older, non-purebred cats with deteriorating clinical signs.

323 For the purpose of this study, we grouped cats with spinal lymphoma into a separate  
324 disease category. The reasons for this were that spinal lymphoma has historically been  
325 considered one of the most common feline spinal disorders and that spinal lymphoma  
326 has been associated with different clinical characteristics compared to other feline  
327 spinal tumors. Lymphoma has been suggested to be the most common spinal tumor in  
328 cats, representing up to 39% of spinal tumors in this species.<sup>26</sup> Compared to cats with  
329 other spinal tumors, cats with lymphoma have been suggested to be younger, have a  
330 more rapid progression of clinical signs, have more often lateralised or asymmetrical  
331 neurological deficits and have more often clinical signs localised to the thoracic or  
332 lumbosacral spinal segments.<sup>26-28</sup> Our results however suggest that it is difficult to  
333 differentiate lymphoma from other feline spinal disorders without further diagnostics.

334 The only clinical variable significantly associated with a diagnosis of spinal  
335 lymphoma was the presence of concurrent clinical signs and abnormalities on general  
336 physical examination. These findings are in agreement with previous suggestions that  
337 spinal lymphoma may be difficult to differentiate from other spinal disorders and that  
338 non-specific signs such as anorexia, lethargy and weight loss commonly precede  
339 neurological signs.<sup>29</sup> It is well-known that some common feline neurological  
340 conditions are expressions of systemic disease, which is illustrated by the fact that  
341 lymphoma, FIP virus myelitis and, spinal empyema were significantly associated with  
342 concurrent clinical signs and abnormalities on the general physical examination. The  
343 presence of such abnormalities was associated with more than thirty times the odds  
344 for the diagnoses of spinal lymphoma and FIP virus myelitis. A diagnosis of FIP virus

345 myelitis was further associated with a young age and a multifocal neuro-anatomical  
346 localisation, which is in agreement with previous studies.<sup>12,13</sup>

347 Although the prevalence of degenerative intervertebral disc disease in the overall  
348 feline population should be considered low<sup>20,30</sup>, this was the second most common  
349 spinal disorder in our study. This condition was significantly associated with middle  
350 aged, purebred cats with no abnormalities detected on general physical examination  
351 that developed an acute onset of progressive and painful clinical signs (Table 2).  
352 These findings are in agreement with previous studies that have reported spinal  
353 hyperaesthesia and progressive clinical signs in the majority of cases<sup>20,30,31</sup> and have  
354 suggested that purebred cats, in particular Persians and British shorthairs are  
355 predisposed for intervertebral disc disease.<sup>20</sup> Previous studies have also suggested that  
356 most cats are young to middle-aged<sup>31</sup> with a mean age at the time of diagnosis  
357 ranging from 9.5 to 9.8 years.<sup>20,30</sup>

358 In agreement with previous findings, spinal fracture and luxation was a common  
359 cause of spinal disease in this study.<sup>6,15</sup> This is not surprising given the partial  
360 outdoors lifestyle of most cats. This condition was associated with young cats that  
361 presented with a peracute onset of a non-ambulatory neurological status and spinal  
362 hyperaesthesia. Spinal fracture and luxation can be considered a severe spinal  
363 emergency in cats. Surgical treatment is technically challenging, expensive and can be  
364 associated with an uncertain prognosis.<sup>15,17,32,33</sup> It is important to realise that cats that  
365 are involved in a traumatic incident can also suffer from other spinal conditions.  
366 Acute non-compressive nucleus pulposus extrusion and spinal cord contusion, two  
367 conditions often associated with external trauma, were also considered common  
368 spinal conditions in this study.<sup>19,21</sup> Treatment of both conditions does not involve

369 surgery, and this illustrates that multiple differential diagnoses should be considered  
370 when a cat is presented after suspected spinal trauma.

371 Ischaemic myelopathy was the fourth most common feline spinal disorder and was, in  
372 agreement with previous studies, associated with a characteristic clinical presentation.  
373 Cats with ischaemic myelopathy were typically older and presented with stable or  
374 improving, non-painful, lateralised clinical signs.<sup>16,34</sup> The presence of improving  
375 clinical signs was considered the strongest clinical indicator for a diagnosis of  
376 ischaemic myelopathy (Table 2). This condition was also associated with a C6-T2  
377 neuro-anatomical localisation, which is in agreement with previous findings.<sup>16</sup>

378 The main limitations of this study were its retrospective study design and the  
379 inclusion of cases without a histopathologically confirmed diagnosis. Although for  
380 most disease categories a diagnosis was based on previously published criteria and a  
381 board-certified neurologist reviewed all diagnostic studies, it is possible that some  
382 cases might have been incorrectly classified. It is possible that this methodology  
383 enabled inclusion of disorders with a more favourable prognosis and provided  
384 therefore a more accurate reflection of the overall caseload seen in a tertiary referral  
385 population. It should however also be emphasized that all included cats were indeed  
386 referred to a specialist referral hospital and all underwent advanced diagnostics. It is  
387 therefore possible that the prevalence of spinal disorders reported in this study cannot  
388 be reliably extrapolated to a first opinion setting. It is possible that easy to diagnose  
389 spinal conditions, such as spinal fracture/luxation, and conditions with mild clinical  
390 signs are less likely referred for further evaluation by specialists. It should further be  
391 emphasized that cats with sacrocaudal luxation or ‘tail pull injury’ were not included  
392 in his study. Although this is a commonly encountered condition, sacrocaudal

393 luxation is associated with specific clinical characteristics<sup>35</sup>, which can be considered  
394 distinct from those of cats suffering from ‘other’ spinal disease.

395

### 396 **Conclusions**

397 Variables from the clinical history, signalment, general physical and neurological  
398 examinations can be systematically evaluated to construct a focused and prioritised  
399 list of differential diagnoses, allowing the implementation of an appropriate  
400 diagnostic and treatment approach. Not only does this help with guiding clients and  
401 their expectations but can also help clinicians increasing their confidence and  
402 decreasing stress when evaluating cats with suspected spinal disease.

403

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### 406 **Conflict of Interest**

407 The authors do not have any potential conflicts of interest to declare.

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410 commercial, or not-for-profit sectors.

### 411 **Ethical Approval**

412 This study was approved by the ethics and welfare committee of the Royal Veterinary  
413 College (SR2018-1663).

414 **Informed consent**

415 Although no specific informed consent was required for this study, all clients had  
416 signed an informed consent during the initial consult that allowed use of the medical  
417 notes for research purposes.

418

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513 **Table captions:**

514 **Table 1:** Prevalence and clinical characteristics of 221 cats with spinal disease

515 **Table 2:** Multivariate logistic regression analysis of signalment, clinical presentation,  
516 and clinical examination characteristics of feline spinal disorders with more than 2  
517 cases.

518

519 **Table legends:**

520 **Table 1:** P = Peracute, A = Acute, S = Subacute, C = Chronic; D = Deteriorating, S =  
521 Static, Imp = Improving

522 **Table 2:** Where statistically significant ( $P \leq 0.05$ ) data presented include Odds Ratios  
523 with 95% confidence intervals (CI) indicated in parentheses