

PARAPARESIS IN CATS: NEUROLOCALISATION AND DIFFERENTIAL DIAGNOSES

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Paraparesis can be defined as an inability to generate a normal pelvic limb gait due to an underlying neurologic cause. This broad definition ensures that the different forms of paraparesis are considered, and it is not just interpreted as overt 'weakness' of the pelvic limb muscles. Paraparesis is frequently accompanied by pelvic limb ataxia, dependent on the site of the lesion responsible. Affected cats may still be able to walk without assistance (ambulatory paraparesis / Grade 2), but they are classified as 'non-ambulatory' once they are unable to take 10 unassisted pelvic limb steps without falling (Grade 3). Mimics of true paraparesis also need to be considered as possible causes of an abnormal pelvic limb gait (see below). Paraplegia refers to a complete absence of voluntary motor function in both pelvic limbs, which may be accompanied by intact (Grade 4) or absent pelvic limb nociception (Grade 5).

LESION LOCALISATION

As for any animal with a suspected neurologic problem, the first and most important step is to perform a thorough neurologic examination to localize the most likely site of a focal lesion to explain all of their signs. If this is not possible, then a multifocal disease process (or the concurrent presence of unrelated / historic deficits) should be considered. For cats with paraparesis, the cranial nerve examination and thoracic limbs should be normal as, by definition, only the pelvic limbs are affected in these cases. If there is thoracic limb involvement, then the cat would be 'tetraparetic' and the list of differential diagnoses may be different.

There are two forms of 'paresis' dependent on the site of the lesion and anatomic structures affected:

- 1) 'Upper motor neuron' - Interruption of the messages from the brain to the nerves that innervate the pelvic limb muscles leading to a reduced degree and a delayed onset of voluntary movement. In these cases, the pelvic limb muscle tone and reflexes are normal, and these limbs could be thought of as waiting for messages that are either slow to reach them or never reach them at all in the case of a paraplegic cat. Concurrent disruption of the ascending sensory pathways from the pelvic limbs to the brain typically results in concurrent pelvic limb ataxia in these cases.
- 2) 'Lower motor neuron' - Loss of pelvic limb muscle strength and tone leading to an inability to support weight against gravity resulting in a short-strided gait, poor pelvic limb joint extension and weak withdrawal reflexes.

Dysfunction of two broad areas of the nervous system will result in these different forms of paraparesis: the T3-L3 spinal cord segments (upper motor neuron), or the L4-S1 spinal cord segments/nerve roots/femoral/sciatic nerves (lower motor neuron). For a lower motor neuron lesion, if the other sacral segments and/or caudal segments are involved, then the anal tone, perineal reflex and tail tone can also be affected. As can be seen below, the neurological examination findings will differ dependent on which of these regions are affected.

	T3-L3	L4-Cd
Mentation, cranial nerves, thoracic limbs	Normal	Normal
Pelvic limb gait and posture	Long strides, ataxic	Short strides, poor joint extension
PL proprioception	Delayed / absent	Delayed / absent
Patellar reflexes	Normal	+/- Reduced / absent
PL withdrawal reflexes	Normal	+/- Reduced / absent
PL +/- tail muscle tone	Normal / increased	Reduced
Perineal reflex	Normal	+/- Reduced / absent
Cutaneous trunci reflex	Possible interruption	Normal

A mention should be made here of cases with neuromuscular weakness. In general, these cases present as generalized weakness of all limbs (tetraparesis), with weak withdrawal reflexes in all limbs and possible cranial nerve involvement (e.g. facial paresis/paralysis). Megaoesophagus is less common in cats with generalized neuromuscular weakness compared to dogs. However, some cats with neuromuscular disorders can present with only pelvic limb involvement, particularly in the early stages of the disease before progression to tetraparesis. This means that they can therefore be mistaken for a lesion affecting the L4-S1 spinal cord segments. One of the most common causes of neuromuscular weakness in young cats is suspected immune-mediated polyneuropathy.¹ Whilst these cats typically present with tetraparesis and generalized weakness, up to one third of cats can present for paraparesis alone.² Diabetes mellitus and myasthenia gravis are other neuromuscular conditions that can present as paraparesis in cats, with a plantigrade stance typical of cats with diabetes.

In addition to neuromuscular disease mimicking a spinal cause of paraparesis, non-neurological mimics of paraparesis need to be considered in any cat presenting with an abnormal pelvic limb gait. A thorough medical history, general clinical and orthopaedic examination are therefore important in these cases. Examples of orthopaedic conditions mimicking paraparesis in cats including gastrocnemius tendon rupture and slipped capital femoral epiphyses.³

Therefore, for any animal presenting with an abnormal pelvic limb gait there are 3 important questions to answer before any tests are performed: Is this a neurological problem? If so, where does the lesion localise? And, what disease process could cause a lesion at this site? This then allows a list of differential diagnoses to be formulated, ideally ranked from most to least likely, and means that you should hopefully know **where to look, what you are looking for and what test(s) you should perform first**.

If your neuroanatomic localization is consistent with a peripheral lesion affecting the L4-S1 nerve roots, femoral and/or sciatic nerves, then the following differential diagnoses should be considered: inflammatory polyneuropathy in young cats, diabetes mellitus-associated neuropathy (affecting 90% of diabetic cats microscopically, with clinical signs in around 10% of insulin-dependent diabetic cats), lymphoma (often associated with signs of systemic involvement) and aortic thromboembolism. The latter is a very important differential diagnosis for acute paraparesis/paraplegia in cats. Obstruction of blood flow to the pelvic limbs results in ischaemic neuromyopathy resulting in pain, paralysis, absent femoral pulses, cold and pale hind paws. In contrast to cats with a spinal cord lesion resulting in paraplegia, motor function of the tail can be maintained in these cases (dependent on the site of vessel obstruction) and attention should always be paid to careful palpation of the femoral pulses, and for muscle swelling and reduced temperature in the affected limbs of paraparetic cats.

Other than aortic thromboembolism, it is more common for paraparesis in cats to result from a lesion affecting the spinal cord than the peripheral nerves. If this is suspected from the general clinical and neurologic examinations, then the following should also be considered when formulating the list of differential diagnoses: What causes of myelopathy are most common in cats in general, the signalment, onset and disease progression, neuroanatomic localisation, lateralisation and the presence / absence of apparent pain.

DIFFERENTIAL DIAGNOSES IN FELINE SPINAL CORD DISEASE

Several studies have investigated which underlying disorders are most common in cats with spinal cord lesions. Some of these are specific to certain areas of the vertebral column, whilst others include lesions affecting any area of the spinal cord and are not specific to those resulting in paraparesis alone.^{4,5,6,7,8} However, unlike in dogs for which intervertebral disc disease is a very common cause of spinal cord dysfunction, a consistent finding of these studies is that neoplastic and inflammatory causes are frequently more common in cats.

Lesion type	Marioni-Henry (2010) – post-mortem study, 205 cats	Goncalves et al. (2009) – clinical and MRI-based, 92 cats*	Benito Benito et al. (2023) – T1-T6 region only, 21 cats	Mella et al. (2020) – 221 cats referred to one centre
Inflammatory / infectious	32% (FIP myelitis in 50% of these)	14%	24%	9%
Neoplasia	27%	27%	43%	27%
Trauma	14% (NB. IVDD included here)	9%	-	24%
Congenital	11%	3%	19%	8%
Vascular	9%	7%	5%	10%
Degenerative	6%	5%	10%	21% (IVDD included here)

*MRI normal in 35% cases

More specific differential diagnoses for cats with paraparesis and an underlying spinal cord lesion (myelopathy) include the following conditions. As described above, a combination of the signalment, clinical history, general clinical and neurological examination findings should be used on a case-by-case basis to determine the most likely differential diagnoses before deciding on the most appropriate diagnostic tests to perform.

- **Thoracic vertebral canal stenosis** – particularly in cats with a chronic, progressive, painful T3-L3 myelopathy localizing to the thoracic region. British shorthair and male neutered cats were over-represented in a study of 9 cats, in which the median age at presentation was 9 years.⁷
- **Intervertebral disc disease (IVDD)** – whilst considerably less common than in dogs (particularly the young-middle aged brachycephalic dog breeds), intervertebral disc disease should still be considered in any cat presenting with paraparesis. It has been reported to be most common in middle-aged, purebred cats with a normal general physical examination and an acute onset, painful, progressive myelopathy.⁸ The prevalence of IVDD in cats has been estimated to be 0.24%, with 55% of 31 cats in this study being purebred (British Shorthair and Persians).⁹ As for dogs, cats can be affected by disc extrusions, annular protrusions and acute non-compressive nucleus pulposus extrusions (ANNPE). Cats with degenerative disc extrusions typically have a shorter duration of more severe clinical signs compared to those with protrusions.⁹ Irrespective of the type of disc disease, paraparesis is a common clinical presentation in cats compared to tetraparesis (86% of cats in one study vs. 14% presenting with tetraparesis).¹⁰ Cats with ANNPE typically present for a peracute onset of paraparesis, with many of these having a history of witnessed or suspected external trauma. Management of these cases is conservative given the absence of spinal cord compression and the prognosis is generally good.¹¹ A recent study reported the outcomes of surgically and conservatively managed thoracolumbar and lumbosacral (compressive) intervertebral disc herniations in cats and found a similar outcome for both approaches, reinforcing the point that the prognosis is not necessarily poor in cats with intervertebral disc herniation for which surgical decompression is not an option.¹²
- **Discospondylitis** – A recent study reported 17 cats with discospondylitis, of which 65% had neurological deficits and all of these had paraparesis.¹³ Spinal hyperaesthesia was present in all

cases but only 3 cats (18%) had pyrexia. Haematology, serum biochemistry and urinalysis were non-specific in all cases and a positive culture was only achieved in 2 cats (17 had urine culture and 9 had tissue culture). Bacterial infection of the epidural space (empyema) can occur secondary to discospondylitis in cats but can also be haematogenous or arise secondary to penetrating injuries to the vertebral column (e.g. bite wounds).

- **Neoplasia** – lymphoma was previously considered the most common neoplasm affecting the spinal cord of cats and should always be considered in cats of any age, particularly in those with concurrent systemic disease. However, more recent studies also report various non-lymphoid neoplasms causing myelopathies in cats, including injection site sarcomas in the thoracic region.
- **FIP myelitis** – this is an important differential diagnosis for spinal cord disease in cats, particularly in young cats with concurrent systemic or ocular signs (e.g. pyrexia, weight loss, body cavity effusion, uveitis) +/- multifocal neurological deficits consistent with brain involvement (meningitis / ependymitis).
- **Spinal fracture/luxation** – there will usually be a consistent clinical history in such cases, or a high suspicion based on the presence of other traumatic injuries or scuffed claws etc. Trauma to the vertebral column was most common in young cats with a peracute onset of painful non-ambulatory paraparesis/paraplegia in one study⁸, and orthogonal radiographs with very careful handling should always be considered in such cases.
- **Ischaemic myelopathy** – whilst more common in the cervical region of cats resulting in tetraparesis, obstruction to the spinal cord vasculature by blood clots, fibrocartilage or neoplastic emboli is a possible cause of paraparesis, and would typically present as an acute, stable or improving, non-painful, lateralising myelopathy.

APPROACH IN PRACTICE

1. Is this a neurological problem?
2. General physical examination +/- signs of systemic disease (e.g. lethargy, weight loss, pyrexia, ocular signs): FIP myelitis, Toxoplasmosis, Lymphoma, Bacterial infection (empyema, discospondylitis)
3. Neurologic examination, combined with the clinical history and signalment
4. Investigations:
 - Haematology, serum biochemistry +/- FeLV, FIV, Toxoplasma serology
 - Imaging of the vertebral column for a spinal lesion
 - Radiography in practice: fracture / luxation, discospondylitis, osteolytic lesions
 - Refer for further assessment and advanced imaging (MRI) +/- CSF sampling
 - Body cavity imaging +/- sampling – neoplasia (e.g. lymphoma) or FIP
 - Symptomatic treatment and close monitoring of the course of the disease
 - **Progressive:** neoplasia, infectious/inflammatory
 - **Potential for improvement with conservative management:** Vascular, ANNPE, IVDD

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