Assessment of Spinal Patients

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Spinal disease in various forms is a reasonably common case presentation in general small animal practice. Indeed intervertebral disc disease is the most common neurological problem presented in general practice. It is important that small animal clinicians have a good working knowledge of spinal neurology so that spinal cases can be properly diagnosed and appropriately managed. This does not necessitate a detailed knowledge of spinal neuroanatomy and neurophysiology. All it requires is a simple systematic approach to spinal assessment (and a co-operative patient and some patience!)

There are **four** questions that need to be answered when assessing a spinal case:

1. Is there a neurological problem?
This is answered by testing postural reactions

2. Where is the problem?
This is determined by testing the spinal reflexes, identifying an area of spinal hyperaesthesia (pain) if it exists, and usually then using radiography or some other imaging technique

3. What is the problem?
This usually requires further diagnostic workup, generally involving plain radiography, and possibly myelography or other imaging techniques.

4. What is the prognosis and appropriate treatment?
The prognosis and appropriate treatment can be assessed from the severity of neurological dysfunction in most cases once the cause of the problem is known.

Neurological examination will answer the first two questions and is an essential part of the process for determining the answer to questions three and four. This will be the focus for this first session.

In the second session, the focus will be on the process of diagnosing the specific problem using diagnostic aids such as imaging, and selection of the appropriate treatment, using thoracolumbar disc disease as the model.

A simple neurological examination is a simple procedure

In order to effectively perform a neurological examination, it is necessary to have:

- a quiet area free of noise and distractions
- a cooperative patient – it is very difficult to perform an accurate spinal assessment in an aggressive animal. Sedation will modify neurological responses.
- sufficient time (admit the animal and do it as a "procedure" after consultations are finished if necessary. Why not charge the client for a neurological examination?)
- a reflex hammer and a pair of haemostats
- a systematic approach (neurological examination is a subjective science in many respects and your "success" will be increased if you take a consistent approach).

The following notes are intended to provide a guide to performing an effective neurological examination for assessment of spinal disease. They can be used in conjunction with a neurological examination sheet. They are not intended to be a comprehensive guide to complete neurological examination for cranial problems.

Mental status

Mental status of the animal should be assessed. This can be done by observing the animal while a history is taken from the owner.
Animals can be classified as:

Alert – normal
Depressed – conscious but less responsive than normal unless aroused by pain
Stuporous – sleeps
Comatose – deep unconsciousness

Spinal cases are usually alert. If they are not then a cranial neurological problem or other systemic disease should be suspected.

Gait

Gait is best observed outside on a non-slippery surface. The typical veterinary clinic floor makes assessment of gait more difficult. Observation of an ambulatory animal outdoors is useful. Assessment of animals with subtle deficits is aided by observation of them negotiating obstacles such as steps, gutters etc.
It is very useful to have animals on the floor while a history is taken from the owner. Observation of gait (or lack of it) over a few minutes during history taking is very helpful. Animals are usually classified as ambulatory +/- ataxic or non-ambulatory. If non-ambulatory the distinction must be made between whether they are para or tetra paretic (weak with some voluntary movement of the limbs) or para or tetra plegic (paralysed with no voluntary movement at all).

Remember:

- **paresis** means weakness and means some voluntary movement is present in the affected limbs, even if the animal is non-ambulatory.
- **plegia**, or paralysis, means absence of any voluntary movement.
- **para**paresis or **para**plegia refer to the hindlimbs
- **tetra/quadra**paresis or **tetra/quadra**plegia refers to all the limbs

IS THERE A NEUROLOGICAL PROBLEM?

Postural reactions

It must be remembered that animals that present apparently ataxic or paretic non-ambulatory may in fact **NOT** have a neurological problem. Testing of postural reactions will answer this question of whether there is a neurological problem or not.
Postural reactions are the complex responses that maintain an animal's normal upright position.
These are ***reactions*** because they involve integrated cerebral cortical input. They are not reflexes.
These answer the question **'is there a neurological problem?'**
While they don't specifically localise spinal lesions the presence or absence of postural reaction abnormalities typically helps in lesion localisation by identifying affected limbs. (For example postural reaction abnormalities of the pelvic limbs with no postural reaction deficits in the thoracic limbs would suggest a lesion caudal to the cervical intumescence.)
Most animals, other than small dogs and cats, are more comfortable and relaxed having these tests performed on the floor rather than on the exam table.

Postural reaction tests include:

- **Conscious proprioception**
- **Hopping**
- **Extensor postural thrust**
- **Wheelbarrowing**
- **Placing reaction**
- **Hemistanding and hemiwalking**

Conscious proprioception.

This is the most sensitive indication of neurological deficit and is the first neurological function to be lost. There are two methods of assessing this.

i. *Knuckling.* Flex the foot so the dorsal surface contacts the ground. The animal should immediately return the foot to a normal position.

ii. *Paper slide test.* Place the foot in a normal standing position and slowly slide the paper laterally. The animal should lift the foot and replace it in a normal standing position. This test is more sensitive for abnormalities in the proximal part of the limb.

NB: It is essential that when testing conscious proprioception that a hand is placed between the legs (either fore or hind limb whichever you are testing) to help maintain the animal's centre of gravity. If this is not done and the animal starts to fall to one side other input, for example the vestibular system, is involved and this may 'override' a conscious proprioceptive deficit.

Hopping.

The patient's weight is supported on one limb and the animal is moved forward, then laterally and medially. Medial movements are more difficult for the animal to do. It is important when doing this to have the animal in as normal a position as possible with respect to the table top or floor that you are using to assess the reaction – if you are lifting them too high from the surface, you will get a falsely poor response.

Extensor postural thrust.

Lift the animal by the thorax with your hands caudal to the thoracic limbs. Lower the pelvic limbs to the floor with the animal in an upright position. To regain its centre of gravity in a normal quadriped position the animal should move the pelvic limbs caudally in a symmetric walking action.

Wheelbarrowing.

The animal is made to take all its weight on the thoracic limbs by the examiner lifting under the abdomen just enough to elevate the pelvic limbs off the ground. A normal response is to make coordinated movements forward and sideways. This test should not be performed if serious spinal injury is suspected that may be exacerbated by this procedure.

Placing reaction.

Placing is evaluated first without vision (tactile placing) and secondly with vision (visual placing). The thoracic limbs are brought into contact with a table edge. A normal animal on tactile placing should 'reach' for the table on contact. In visual placing a normal animal will 'reach' for the table before contact.

Hemistanding and hemiwalking.

This is not usually tested in spinal cases. It is most useful in assessing animals with cerebral cortex lesions.

Remember:

In the spinal cord loss of function progresses in the following <u>reliable</u> sequence:

1. **loss of proprioception**
2. **loss of voluntary movement**
3. **loss of superficial pain**
4. **loss of deep pain**

WHERE IS THE NEUROLOGICAL PROBLEM?

Spinal reflexes

These test the integrity of the sensory and motor components of the local reflex arc and the influence of descending motor pathways on the reflex.
They are a **reflex** not a reaction and do **not** involve cerebral integration. They are mediated at the local level. (This is a very important distinction. For example a dog with a completely severed spinal cord at the thoracolumbar junction will have absent postural reactions in the hindlimbs but will have *increased* spinal reflexes in the hindlimbs)
They answer the question **'where is the problem'** in the spinal cord.

When assessing spinal reflexes three kinds of reflexes only will be seen:

- **normal**
- **decreased/absent**
- **increased**

Grade each reflex tested in this way and record this information on a neurological examination sheet. This information is then used to localise the affected spinal cord segment.

A **decreased (↓) or absent (-)** response is a **lower motor neuron reflex** which indicates a partial or complete fault in either the sensory or motor components (Lower Motor Neuron) of the reflex arc.

Lower motor neuron cell bodies (LMN) are found in the spinal cord grey matter. Their axons form part of the peripheral nerve and insert in the muscle.
The LMNs of the thoracic limbs have their cell bodies in the cervical intumescence (C6 – T2 spinal cord segments). The LMNs of the pelvic limbs have their cell bodies in the lumbar intumescence (L4 – S1 spinal cord segments). Urethral and anal sphincter LMNs arise from S1 – S3 spinal cord segments.

Signs of LMN dysfunction may be seen with damage/disease to either the spinal cord segments from which the LMNs originate, from damage/disease to the peripheral nerve, or from muscle disease.

Signs of LMN disease are:

- **decreased or absent reflexes**
- **depression or loss of voluntary movement**
- **decreased or absent muscle tone**
- **severe atrophy of an affected muscle in a short time period**

An **increased or exaggerated (↑)** response is an **upper motor neuron reflex** and indicates an abnormality in the upper motor neuron pathways (UMN).
Normally the UMN has an inhibitory effect on the LMN.
An UMN reflex suggests a lesion ***cranial*** *to the spinal segment tested*.

UMN cell bodies are located in the brain. Their axons descend in the spinal cord and terminate on interneurons that synapse with the LMNs in the cervical or lumbar intumescences.

Signs of UMN disease result from damage to the descending UMN axons and subsequent loss of the inhibitory effect of the UMN on the LMN.

Signs of UMN damage/disease are:

- **exaggerated spinal reflexes**
- **depression or loss of voluntary movement**
- **increased muscle tone**
- **slow muscle atrophy due to disuse**

By testing the spinal reflexes and grading them as either upper or lower motor neuron reflexes, the exact segment of the spinal cord that is affected can be determined.

The spinal cord can be divided into four basic functional segments that can be identified by assessment of spinal reflexes and that allow localisation of spinal lesions:

- the cervical segment (C1 – C5)
- cervical intumescence (C6 – T2)
- thoracolumbar segment (T3 – L3)
- lumbar intumescence (L4 - Cd5) and cauda equina.

The grading of each reflex should be recorded on a neurological examination sheet. On completion of the neurological examination refer to the table below to identify the affected spinal cord segment.

Muscle tone is also assessed during the spinal examination. Abnormalities in the muscle tone are assessed in the same way as spinal reflexes. That is, exaggerated muscle tone suggests an UMN lesion while decreased or absent muscle tone indicates a LMN lesion.

Localisation of Spinal Lesions by Segmental Reflexes

Cord Segment	Forelimb reflexes	Hindlimb reflexes
Cervical (C1 - C5)	UMN	UMN
Cervical Intumescence (C6 - T2)	LMN	UMN
Thoracolumbar (T3 - L3)	Normal	UMN
Lumbar Intumescence (L4 - Cd5)/cauda equina	Normal	LMN

Identifying a local area of spinal hyperaesthesia (pain) is an excellent and generally reliable method of lesion localisation. It should be used to confirm the results of your neurological testing. Remember though that not all spinal lesions are painful.

Cervical (C1 - C5) lesion

Postural reaction deficits are usually apparent in all limbs.
UMN reflexes will be elicited in both the thoracic and pelvic limbs.
Muscle tone is usually normal or increased. Muscle atrophy is not usually a feature although disuse atrophy will become apparent in chronic cases.
Ataxia and tetraparesis are usually seen. It should be noted, however, that in some cases paraparesis only is seen, with minimal postural reaction deficits of the forelimbs,. The reasons for this are not fully understood.
Cervical hyperaesthesia (pain on cervical manipulation) is commonly seen. A “root signature”, due to compression of the nerve root, may be evident as the animal will hold the affected limb slightly off the ground.
Horner’s syndrome (miosis, ptosis and enophthalmos) may rarely be observed.
Tetraplegia and loss of superficial and deep pain are rarely seen in cervical segment lesions as injuries of this severity are usually fatal due to respiratory paralysis.

Cervical Intumescence (C6 – T2) lesion

Postural reaction deficits are usually apparent in all limbs. This may however be more marked in the pelvic limbs.
LMN reflexes will be apparent in the thoracic limbs and UMN reflexes in the pelvic limbs.
Muscle tone will be similarly normal to depressed in the thoracic limbs and normal to increased in the pelvic limbs. Muscle atrophy is usually severe in the thoracic limbs and only becomes apparent in the pelvic limbs in chronic cases due to disuse atrophy.
Ataxia and tetraparesis are usually observed (although as with cervical segment lesions the thoracic limbs may be less severely affected.)
Panniculus reflex may be absent or depressed in its entirety either unilaterally or bilaterally with lesions affecting T8 – C1 cord segments (as this is where the motor nerve for the panniculus muscle originates)
Horner's Syndrome is commonly observed with lesions affecting T1 – T3 cord segments.
Cervical hyperaesthesia (pain on direct palpation of the area) is commonly seen. A "root signature", due to compression of a nerve root, may be evident as the animal will hold the affected limb slightly off the ground.

Thoracolumbar Segment (T3 – L3)

Postural reaction deficits are only apparent in the pelvic limbs.
Thoracic limb spinal reflexes and muscle tone will be normal. UMN reflexes and normal to increased muscle tone will be apparent in the pelvic limbs.
Muscle atrophy of the pelvic limbs is only a feature in chronic severe lesions due to disuse and this develops slowly.
Paraparesis or paraplegia may be observed depending on the severity of the lesion.
Pain perception is normal in the thoracic limbs and, depending on the severity of the lesion, may be normal, reduced or absent in the pelvic limbs.
Hyperaesthesia may be detectable in the thoracolumbar area and if so is a useful localising sign.
Panniculus reflex may be absent in part either unilaterally or bilaterally caudal to the lesion.
Urinary incontinence, and rarely faecal incontinence, may be seen. There may be increased tone of the detrusor muscle and urethral sphincter, a so-called "UMN bladder". This is usually manifest as a reflex dyssynergia or an overflow incontinence. The bladder is difficult to manually express due to the increased urethral sphincter tone. It is important to differentiate a UMN bladder, which is difficult to express, from a LMN bladder (seen with lumbar intumescence lesions) which is easily expressed due to the weak LMN urethral sphincter.
Schiff-Sherington Syndrome may be seen in acute severe spinal cord injuries to the thoracolumbar segment. This is characterised by markedly increased muscle tone in the forelimbs (extensor rigidity), hyperextension of the neck, and UMN reflexes and muscle tone in the pelvic limbs. It is a poor prognostic sign and must be differentiated from a cervical segment lesion with UMN reflexes in *all* limbs.

Lumbar Intumescence (L4 – Cd5) and Cauda Equina

Postural reaction deficits of the pelvic limbs are seen. The thoracic limbs are normal.
Spinal reflexes and muscle tone of the pelvic limbs are reduced or absent (LMN).
Muscle atrophy in the pelvic limbs is rapid and profound.
Depending on the severity of the lesion paraparesis or paraplegia may be seen.
Urinary and faecal incontinence, characterised by "overflow" incontinence, may be seen. A "LMN bladder" is overfull and easily expressed and often continually dribbles. The rectum may become distended with faeces leading to inappropriate defaecation often when the animal is picked up.

Remember: Spinal reflexes include three groups of reflexes:

- **myotatic (stretch) reflexes**
- **withdrawal (flexor) reflexes**
- **other miscellaneous reflexes**

Myotatic (stretch) and direct reflexes.

Myotatic reflex: spinal reflex elicited by the stretching (tapping) of a muscle tendon, which causes a reflex muscle contraction.

Hindlimb.

Patellar reflex. The patellar reflex is the most reliable of the spinal reflexes. Support the stifle in a slightly flexed position and strike the patellar ligament with a reflex hammer or plexor. A normal response is a quick extension of the stifle. As with all reflexes assessment is subjective and needs to be compared to the contralateral limb and to normal animals based on the examiner's experience. Reflexes at each end of the spectrum (ie absent or markedly increased) are easy to assess. Subtle differences are harder to interpret.
A LMN reflex indicates a lesion between L4-L6. An UMN reflex indicates a lesion cranial to L4.

Sciatic reflex. (Not truly a myotatic reflex but a direct reflex) Place a finger in the groove between the greater trochanter and the ischiatic tuberosity. Strike the finger with the plexor. Response is flexion of the stifle.
A LMN reflex indicates a lesion between L6 and S1. An UMN reflex indicates a lesion cranial to L6.

Cranial tibial reflex. The belly of the cranial tibial muscle (which is lateral to the tibial crest) is struck with the reflex hammer just distal to the proximal end of the tibia. Normal response is hock flexion.
This is testing a branch of the sciatic nerve. A LMN reflex indicates a lesion between L6-L7. Caution – this is a difficult reflex to elicit in a normal animal so interpret a depressed

or absent cranial tibial reflex in consideration of the other findings. An exaggerated reflex is more reliable and indicates a lesion cranial to L6-L7. Note: with a LMN lesion of the sciatic nerve the patellar reflex may appear exaggerated. This is due to a loss of function of the flexor muscles, which are innervated by the sciatic nerve, allowing unrestrained action of the quadriceps muscle which is innervated by the femoral nerve.

Common peroneal reflex. (Not truly a myotatic reflex but a direct reflex) This also tests a branch of the sciatic nerve. The reflex can be elicited just caudal to the fibular head. A normal reaction is flexion of the hock and extension of the digits. A LMN reflex indicates a lesion at L6-S1. An UMN reflex indicates a lesion cranial to L6.
Note: as with the cranial tibial reflex this is difficult to interpret and interpretation should be made with consideration of other findings.

*Gastrocnemius reflex. S*trike the Achilles tendon (gastroc) just above the calcaneus with the hock slightly flexed. A normal response is extension of the hock. A LMN response indicates a lesion at L7-S1. An UMN response indicates a lesion cranial to L7.
Note: this is less reliable than the cranial tibial or common peroneal reflexes.

Forelimb.

Extensor carpi radialis reflex. Support the limb under the elbow with the elbow and the carpus slightly flexed and strike the extensor carpi radialis muscle (craniolateral aspect) just distal to the elbow. A normal response is a slight extension of the carpus. NB The limb must not touch the floor or the opposite limb or the reflex will be inhibited. This muscle is innervated by the radial nerve (from C7, C8, T1 spinal segments).
Note: this reflex is somewhat difficult to evaluate but usually can be elicited. However evaluate absent or ↓ reflexes with caution. An ↑ reflex means a lesion cranial to C7.

Triceps reflex. Evaluate this in the same position as the extensor carpi radialis reflex. Strike the triceps tendon just proximal to its insertion on the olecranon. A normal response is slight extension of the elbow. This muscle has the same innervation as the extensor carpi radialis ie radial nerve from C7, C8, T1. The reflex is difficult to elicit so interpret absent or ↓ reflexes with caution. Exaggerated reflexes are interpreted as for exaggerated extensor carpi radialis reflex ie lesion cranial to C7.

Biceps reflex. While holding the elbow slightly flexed the index finger of the same hand is placed on the biceps and brachialis tendons cranial and immediately proximal to the elbow. The finger is struck with the reflex hammer. A normal response is slight flexion of the elbow. The biceps muscle is innervated by the musculocutaneous nerve from C6-C8 spinal segments. This reflex is very difficult to elicit so an absent reflex cannot reliably be interpreted as abnormal. An ↑ reflex is significant and means a lesion cranial to C6.

Flexor reflexes (withdrawal reflexes).

These are reflexes are performed in the same position as the other reflexes ie lateral recumbency. A noxious stimulus is applied to the foot. This should be the **least** noxious stimulus that will achieve withdrawal of the foot. **Immediately** the foot starts to withdraw the stimulus is removed. In some animals the necessary stimulus is as little as brushing the hairs around the toes. It is usually **not** necessary to use haemostats. **This is <u>not</u> an assessment of deep pain**. The limb prior to testing should be slightly extended to allow

flexion. The withdrawal reflex is less precise than the stretch reflexes as they involve **all** the limb flexors and therefore involve more spinal cord segments.

One of the most common mistakes made is that the withdrawal *reflex* is confused with the pain *response.* (For example an animal with a completely severed spinal cord at the thoracolumbar junction will have an exaggerated UMN withdrawal reflex but will have no pain response)

Pelvic limb.

Both medial and lateral digits should be tested. The sensory nerves from the digits of the hind limbs are branches of the sciatic nerve (superficial peroneal on the dorsal surface and the tibial nerve on the plantar surface). The exception to this is the medial toe, which is partly innervated by the saphenous nerve, a branch of the femoral nerve. The pelvic limb withdrawal therefore involves spinal cord segments L6-S1 and the sciatic nerve. Bilateral LMN reflex suggests a lesion between L6-S1 whereas a unilateral lesion would more commonly be seen with a peripheral neuropathy of the sciatic nerve (although this can also be seen with a unilateral spinal cord lesion). An exaggerated reflex indicates a lesion cranial to L6.

Thoracic limb.

This is tested as for the pelvic limb. In addition to testing medial and lateral digits, the dorsal and palmar surfaces should also be tested.
The cranial surface is innervated by the radial nerve (C7, C8, T1)
The medial palmar surface is innervated by the ulnar and median nerves (C8, T1).
The lateral palmar surface is innervated by the ulnar nerve (C8, T1).
In summary the sensory nerves are supplied from spinal segments C7, C8 and T1.
The flexor muscles are innervated by the axillary, musculocutaneous, median, ulnar and radial nerves which are supplied by spinal cord segments C6 – T1.
Depressed or absent reflexes indicate a lesion at C6 – T1. If reflexes are variable depending on cutaneous area tested a peripheral nerve lesion is most likely (see cutaneous mapping).

Other reflexes.

Perineal reflex.
This is elicited by stimulation of the perineum with forceps (or thermometer). As with withdrawal reflexes the minimum stimulus necessary to elicit a response is used. A normal response is contraction of the anal sphincter and a 'protective' flexion of the tail. Exaggerated reflexes are more difficult to appreciate than absent perineal reflexes. More sensitive assessment may be aided by rectal examination.
This reflex receives sensory and motor innervation from the pudendal nerve (spinal cord segments S1, S2). Absent or decreased perineal reflex indicates a sacral spinal cord lesion or a pudendal nerve lesion.

Panniculus reflex (cutaneous trunci muscle reflex).
Sensory nerves from the skin enter the spinal cord about two vertebrae cranial to the area of cutaneous testing and ascend within the white matter up to the cervicothoracic

junction. The motor nerve to the cutaneous trunci muscle exits the spinal cord at C8 - T1 segments.
This reflex can usually be elicited between the pelvis and the shoulder. Exaggerated reflexes are very difficult to assess. Absent or decreased reflex usually means a lesion approximately two vertebrae cranial to the area tested or, if absent entirely, a lesion at C8 – T1.

Crossed extensor reflex. This is seen when withdrawal reflex is tested and involves extension of the limb **not** being tested. This reflex is **normal** if the animal is standing but is abnormal in lateral recumbency. A crossed extensor reflex is an UMN reflex. It is not a reliable indicator of severity.

WHAT IS THE PROGNOSIS?

Sensory Examination / Pain response.

Superficial pain, deep pain and areas of hyperaesthesia are usually tested as the ***last*** part of a neurological examination. This is to prevent losing the "cooperation" of the patient.
Test the pelvic limbs first.

> **Remember:** With an increasing degree of spinal cord damage neurological function is lost in a reliable sequence – first proprioception is lost, then voluntary movement, then superficial pain and finally deep pain. So there is no need to test for superficial and deep pain if an animal still has voluntary movement or

Superficial pain

Superficial pain is tested by squeezing the skin with the fingers. A significant **response** that indicates the animal perceives the pain is necessary (eg looking around, yelping etc).

Remember that withdrawal **reflex** is **NOT** a pain **response**.

Use the minimum stimulus necessary to invoke a pain **response.**
Do not proceed to test deep pain if superficial pain is present.

Deep pain.

If superficial pain response is not present the degree of stimulus should be increased until a significant behavioural response is elicited. This may mean squeezing the toe with haemostats. Absence of deep pain indicates a severely damaged spinal cord. As deep pain is the last neurological function to be lost this indicates a poor prognosis.

Hyperaesthesia

Discreet painful areas help localise spinal problems that are painful. It is important to assess this information with the other localising tests performed.
Palpate the vertebrae starting caudally at L7-S1 and working cranially. Look for tensing of the lumbar or abdominal muscles or a pain response. Record local areas of hyperaesthesia.

Cranial Nerve Examination

Cranial nerves should be assessed as part of the general physical examination. Cranial nerve abnormalities are unusual in spinal problems but do occur. If abnormalities are detected a full cranial nerve examination is warranted.

Conclusions

- Postural reactions answer the question "is there a neurological problem?" and help in lesion localisation.
- Postural reactions should be assessed first in the neurological examination.

- Spinal reflexes answer the question "where is the problem?" by localising the affected spinal cord segment.
- Spinal reflexes are assessed second after determining there is a problem.

- History, neurological examination and diagnostic aids will help answer the question "what is the problem?"
- Diagnostics such as radiography should be performed after, and be guided by, the neurological examination.

- Presence or absence of superficial and deep pain and the degree of neurological dysfunction will determine the prognosis and appropriate treatment.

- Testing for pain should be the last part of a neurological examination and is only necessary in paralysed animals.
- The minimum stimulus necessary to elicit a pain *response* is used and is only necessary if proprioception and voluntary movement are lost.

- A neurological examination, when done systematically, is a relatively simple procedure:

    1. Take a history while observing the animal
    2. Test postural reactions
    3. Test spinal reflexes. (Refer to notes to localise the affected spinal cord segment)
    4. Assess pain sensation *if indicated*

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Spinal Surgery – Procedures and Aftercare

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This session will focus on the assessment, surgery and postoperative care of patients with IVDD, concentrating mainly on thoracolumbar disc disease. Case examples will be used to illustrate the important points with particular reference to diagnostic aids, surgical procedures and prognosis.

Spinal disease is a reasonably common case presentation in general small animal practice. Intervertebral disc disease (IVDD) is the most common neurological problem presented in general practice. The majority (almost 85%) of disc disease occurs in the thoracolumbar area of the spine. Cervical disc disease and lumbosacral disc disease are less common. Spinal trauma such as fractures and dislocations are very uncommon and present major treatment challenges.

It is important that all staff involved in the care of small animal spinal patients, including nurses and technicians, have a good understanding of managing patients with spinal problems and be very familiar with assessing spinal patients both pre-operatively and post-operatively.

There are several questions that need to be considered initially when assessing a spinal case prior to surgery and then reassessed daily post surgery to monitor progression:

1. What is the severity of the neurological problem?
There are a number of grading systems. An effective and simple grading system for **thoracolumbar** spinal problems is:

Neurological grade	Description of severity	Clinical findings
1	Pain only. No neurological deficits	Able to walk without ataxia but often reluctant to walk because of pain. May have a "hunched" back
2	Ambulatory paraparesis	Still able to walk around though are often weak or ataxic in the hindlimbs
3	Non-ambulatory paraparesis	Unable to walk or stand due to the severity of the paresis. "Drag" their hindlimbs around but some voluntary movement of the hindlimbs is apparent.
4	Paraplegia	Unable to walk or stand due to paralysis. "Drag" their hindlimbs around but there is no voluntary movement of the hindlimbs. Pain response is still present
5	Paraplegia with no deep pain present	Unable to walk or stand due to paralysis. "Drag" their hindlimbs around but there is no voluntary movement of the hindlimbs. Pain response is absent

Some useful definitions:

- Paresis: *partial* loss of motor function (=movement)
- Paraparesis: partial loss of motor function to the hindlimbs
- Tetraparesis: partial loss of motor function to all limbs
- Plegia: = paralysis: *complete* loss of voluntary motor function
- Paraplegia: paralysis of the hindlimbs
- Tetraplegia: paralysis of all limbs
- Reflex: *involuntary* movement in response to some stimulus. This is **<u>not the same</u>** as a pain response.
- Pain response: is a *voluntary* response or reaction on the dog's part (e.g. yelps, turns head) showing that it is aware of a painful stimulus. This is **<u>not the same</u>** as a reflex.

Why do you need to bother with a grading system?

There are two main reasons:

- Firstly the neurological grade gives a good guide for the best treatment option *and* for the likely treatment outcome or prognosis for that patient.
- Secondly it allows you to assess and monitor the progress of the patient following surgery.

As the spinal cord recovers from injury, the return of nerve function occurs in a predictable way; essentially it is the progressive reversal of the features listed in the grading system.

Remember:

In the spinal cord loss of function progresses in the following <u>reliable</u> sequence:

1. **loss of proprioception**
2. **loss of voluntary movement**
3. **loss of superficial pain**
4. **loss of deep pain**

Do you always need to test whether the dog can feel pain in his toes?

This is a definite NO! Only paralysed animals need to be assessed for the presence of pain sensation. If a patient has any voluntary movement present in a limb then it is not necessary to test for the presence of pain.

Spinal patients usually need quite a lot of fairly intensive one-on one nursing care. It is important that they are as comfortable as possible and as confident with the nurse or technician caring for them as possible. This makes both their recuperation and your job as easy as possible. The last thing a hospitalised spinal patient needs is to be hurt by someone testing for the presence of pain when it is unnecessary.

So when do you need to test for pain sensation in spinal patients?

It is only necessary to test for the presence of pain sensation in spinal patients **when they are paralysed.** If they have *any* voluntary movement then they *must* have pain sensation. Testing for the presence of pain sensation when a dog has any amount of voluntary movement is not necessary – even if they are non-ambulatory.

DO NOT test for the presence of pain sensation in the affected limbs of dogs with any amount of voluntary movement – it is unnecessary

2. What is the situation with bladder and bowel function?

Dogs with grade 3, 4 or 5 thoracolumbar spinal disease (and sometimes grade 2) typically have some degree of dysfunction of their bladder and bowel. This requires initial assessment and careful nursing and monitoring to prevent significant complications.

The more severe the grade of neurological injury the greater the likelihood of significant bladder dysfunction

Because the nerves that control the bladder exit the spinal cord at the level of the sacrum they are not damaged in injuries to the thoracolumbar spinal cord. Unfortunately the upper motor neurone nerves that take the messages from the brain, to tell the bladder to contract and the urethral sphincter to relax to allow urine to exit the bladder, are damaged. This means that the bladder tends to become over full quite quickly. This is a source of considerable discomfort in our patients and, if left long enough (similar to a blocked cat with FLUTD) can cause significant stretching damage to the "tight junctions" of the bladder cells and post renal azotaemia.

3. What is the owner's physical, emotional, financial and time capacity for managing this dog during the recovery period?

Typical convalescent / physio recovery periods after spinal surgery are 30 days. In cases of severe spinal cord injury recovery periods can be considerably longer. Likely postoperative outcomes should be discussed with owners prior to surgery or other treatment so that they may make fully informed decisions about what they consider is the most suitable option for their pet.
Similarly during the postoperative period owners should be kept fully informed of their pet's progress. If hospitalisation is likely to be prolonged involving the owners in some part of their pet's daily care, particularly in the physiotherapy, is useful.

Care Before and After Spinal Surgery

Analgesia

Spinal problems are painful. Often the extent of pain that a spinal patient is suffering is only apparent once the problem has been resolved. This is particularly so in chronic cases particularly of cervical intervertebral disc disease.
Analgesia is an essential component of managing spinal problems.

Opiates are recommended for analgesia in spinal patients. Peri-operative morphine combined with a Fentanyl patch is an effective way of providing opiate analgesia in hospitalised patients.

Non-steroidal anti-inflammatory drugs (NSAIDs) are recommended (COX-2 selective or Coxibs) as a component of a balanced analgesia protocol for spinal patients. If gastrointestinal disease (diarrhoea or melaena) should develop post-surgery or the animal is inappetant NSAID usage should be suspended and GIT protectants administered (see below under GIT disease).
NSAIDs are contraindicated if corticosteroids (including MPSS) have been previously administered.

Corticosteroids have long been a cornerstone of medical treatment for spinal problems despite significant doubts existing over any positive benefits (other than analgesic benefits) from their use and clear evidence of frequent complications, some of which can be irreversible. Corticosteroids cause gastrointestinal (GIT) bleeding in approximately 15% of patients and are estimated to cause intestinal perforation and death in approximately 2% of spinal patients.
Animals with spinal problems are more prone to GIT ulceration than normal animals. Spinal injury leads to an imbalance of autonomic control resulting in excessive vagal tone, paralytic vasodilation and a decrease in blood flow through the gastrointestinal mucosa.
The use of corticosteroids contraindicates the use of NSAIDs in spinal patients. The use of GIT protectants is advisable if corticosteroids are used in spinal patients.

Dexamethasone is the most likely of the corticosteroids to cause problems in spinal patients. There is NO indication for the use of dexamethasone in spinal patients.

Methlyprednisolone sodium succinate (MPSS) is a type of corticosteroid that has been used in both humans and animals with spinal injury. MPSS acts as a free-radical scavenger. (Free-radical induced lipid peroxidation is thought to be one of the key components of irreversible spinal damage.)

The use of MPSS in small animal patients with spinal injury is controversial.
MPSS has been shown in one study to be beneficial in humans who received MPSS within 8 hours of spinal injury though several recent studies have questioned the validity of this finding. Use of MPSS in humans >8 hours after injury has been shown to be detrimental.

Data in small animals to support benefits from the use of MPSS is currently lacking. MPSS has been shown to cause significant sub-clinical gastric ulceration in 90% of dogs treated with MPSS prior to spinal surgery and has been associated with an increased occurrence of diarrhoea and melaena in spinal patients.

Moving spinal patients

Conscious animals usually "stabilise" their spine to some degree through splinting of their epaxial musculature. This protective effect is lost when they are anaesthetised or heavily sedated.
Anaesthetised spinal patients should be moved with caution taking care to support the affected part of their spine and to prevent rotatory movements of the spine. A spinal board or stretcher may be useful in larger dogs.
Spinal trauma patients should be moved on a spinal board or similar and care taken when obtaining radiographs. Horizontal beam radiographs in lightly sedated patients should be considered in these cases. Approximately 20% of animals with spinal trauma have multiple fractures or luxations; survey radiographs of the entire spinal column should be taken.
Recumbent tetraparetic animals need to be carefully turned every 2-3 hours to limit ventilatory problems and decubital ulcers. This limits the proper care of these sort of patients generally to hospitals with intensive or high-dependency wards.

Gatrointestinal problems

Diarrhoea is not uncommon in spinal patients, especially those that have received corticosteroids. Diarrhoea increases the risk of urinary tract infection especially in animals with indwelling urinary catheters. Translocation of GIT bacteria can cause bacteraemia and potentially sepsis though this is uncommon.

If GIT problems develop post spinal surgery and an NSAID is being use, treatment should be discontinued and the animal treated with a H2- receptor antagonist such as cimetidine or ranitidine, pantoprazole (or omeprazole) a proton pump inhibitor and / or a mucosal protectant such as sucralfate. Misoprostol, a synthetic prostaglandin, may also be of benefit.
These "gut protectants" are ineffective in preventing or treating corticosteroid-related GIT problems.

Duodenal and colonic perforation is associated with the administration of repeated doses of dexamethasone and the combination of NSAIDs with corticosteroids. It is almost invariably fatal. Prevention of perforation is the best "treatment";

- avoid the use of dexamethasone
- do not use NSAIDs after corticosteroids have been used
- cease usage of NSAIDs if GIT signs develop or the dog is not eating
- administer gut protectants if GIT signs develop

Constipation is occasionally a problem in dogs that have a protracted recovery or remain paraplegic. Enemas should be avoided as they may increase the

likelihood of colonic perforation particularly in the perioperative period. Constipation can usually be managed / avoided with high fibre diets +/- additives such as metamucil. Digital evacuation of the rectum is rarely necessary.

Bladder and Perineal Care

Spinal patients with diarrhoea or urinary incontinence that is not being effectively managed with an indwelling urinary catheter are at increased risk of perineal inflammation, perineal infection and decubital ulcers. Keeping the perineal area clean and dry is very important. Good nursing care and strict attention to bedding condition are invaluable. Bathing the animals is often necessary but care must be taken to ensure that they are completely dry before being returned to their cage. This can be difficult in long haired animals; clipping should be considered in these animals.

In non-ambulatory paraparetic (thoracolumbar grade 3) and paraplegic (thoracolumbar grades 4 and 5) patients the use of an indwelling urinary catheter simplifies perineal care. Dogs with grade 3, 4 or 5 thoracolumbar spinal disease (and sometimes grade 2) typically have some degree of dysfunction of their bladder. This requires frequent checking and either manual expression of the bladder, placement of an indwelling urinary catheter or intermittent catheterisation.

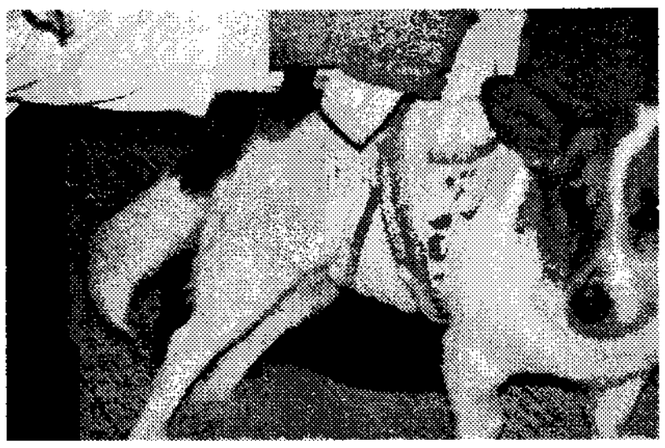
Non-ambulatory animals are more prone to urinary tract infection because of incomplete bladder emptying that predisposes them to retention cystitis. Maintenance of an indwelling urinary catheter has been shown to further increase this risk however the benefits of keeping the perineum (and the animal!) clean and dry outweigh this risk in the authors' opinion. The use of closed systems and good nursing care has been shown to be effective in preventing the occurrence of infection in the first four days. Infection rates rise sharply after 4 days.

The use of silicone Foley catheters connected to a closed urine collection system works well. Antibiotics should be avoided if possible while the urinary catheter is in place to limit development of resistant bacteria. Strict attention to hygiene and good nursing care is important in successful catheter management.

Twice daily cleaning of the vestibule or the prepuce with saline +/- dilute (0.02%) chlorhexidine may reduce the likelihood of infection.

On removal of the catheter urinary culture and sensitivity should be performed on a cystocentesis sample and also on a swab from the catheter tip after catheter removal. Broad spectrum antibiotics can then be commenced pending the results of the bacterial culture.

"Towel-walking" where pressure is placed on the urinary bladder is useful in assisting bladder emptying though is unlikely to fully empty the bladder.



Physiotherapy

Passive range of motion (PROM) exercises and massage can be started during recovery from anaesthesia provided that the patient is suitably analgesed. Ideally this will be performed for 15-30 minutes three or four times daily. This is quite time consuming and involving the owners in this process is beneficial for several reasons.

Massage should begin in the distal extremities and move proximally up the limbs to facilitate venous return and prevent peripheral oedema.

Paraplegic animals can be "walked" with either a hindlimb sling, towel walking or tail walking (pictured).

Tetraplegic animals can be walked with a combination of a forelimb and hindlimb harness.

It is important that the owners and any staff who will be involved with lifting or "walking" a spinal patient are properly informed of safe methods of lifting. Lifting frames or hoists should be used for large or giant breed dogs if available.
Hydrotherapy is an excellent form of physiotherapy in dogs that are comfortable with water. With patience most dogs will come to tolerate and enjoy their hydrotherapy sessions. It is important that animals are thoroughly dried after hydrotherapy sessions.
Hydrotherapy can commence once the surgical wound is sealed – usually 3-5 days post surgery.

Spinal Surgical Procedures

Several options exist for surgical management of spinal problems depending on the cause of the problem, the location and surgeon preference. Some of the more common surgical procedures will be reviewed using case studies.

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