



NEUROLOGICAL EXAMINATION OF THE CAT MADE SIMPLE: Part Two

Jeremy Rose VetMB BA DipECVN MRCVS Teaching Fellow in Neurology.

Performing and interpreting a neurological exam in cats can present a particular clinical challenge to any vet. In the second of this two part article, Jeremy Rose, Senior Clinical Training Scholar in Neurology, takes us through a step-by-step approach to the hands on neurological examination of the cat.

The first part of this article focused on why we perform neurological examinations, and how to use a systematic approach to observe the cat from a neurological aspect. The hands on examination of the cat is the second part of the examination and when the findings are put together with those of the observational exam, a differential list can be formed.

PART 2 - HANDS ON EXAMINATION

1. Postural Reactions

The anatomic pathways involved in postural reactions incorporate receptors in the joints, tendons, muscles and inner ear, their associated nerves and ascending spinal tracts connecting to the forebrain via the brainstem, the descending spinal tracts (i.e. UMN [upper motor neurone] segment) and peripheral motor nerve and skeletal muscles (i.e. LMN [lower motor neurone] segment). Deficits to these tests therefore do not localise to a specific region, but are sensitive indicators to the presence of neurological disease.

When testing postural reactions, try to be as consistent and symmetrical as possible in your method as it is easy to create a 'deficit' in a normal patient through lack of consistency. For neurolocalisation purposes, the primary aim is to decide which limbs are affected: all four legs, just the hind limbs, one side of the animal or just one limb. Use findings on gait to cross check for consistency of the presence of deficits in particular limbs and remember to take into account any orthopaedic injury that could cause changes to these tests if not performed appropriately.

Proprioceptive paw placing

It is important that the patient is bearing the same amount of weight on all four legs to allow responses to be comparable. Supporting the majority of the cat's weight improves sensitivity as a cat with a painful limb (e.g. due to cat bite abscess or fracture) is more likely to still correct the position of the paw. Turn the dorsal

surface of the paw over onto the table and the patient should quickly replace the paw to a normal position. This is not always a reliable test in cats and as a result it is important to interpret this test in addition with information from the gait and other postural reactions, such as hopping.

Visual & tactile placing

Visual placing involves the visual anatomical tract in addition to the motor cortex and postural reaction tracts. To test visual placing, the patient should be held a short distance away from a table allowing an unobstructed field of view and then brought up to the edge of the table top. The normal reaction is for the cat to voluntarily place the limbs closest to the table onto the table top, before the edge of the table is touched with the dorsal surface of the paws. Tactile placing involves covering the eyes and performing the same test. The normal reaction is as soon as the distal limb makes contact with the table, the patient should lift the limb onto the table top. Test both fore- and hindlimbs.

Hopping, hemi-hopping & wheel-barrowing

Hopping tests do not require conscious co-operation and are therefore a more reliable test of proprioception than paw placing, however in cats this test can sometimes be difficult to interpret due to not always giving a reliably repeatable result. To test the thoracic limbs, lift the hind limbs off the floor and then pick up one of the thoracic limbs (slightly flexing the elbow) so that the animal is bearing weight on one limb and gently push the patient laterally while keeping its body perpendicular to the ground. Repeat for the other forelimb. To test the pelvic limbs, lift the forelimbs and one pelvic limb from the floor surface and hop laterally, as for the forelimbs. The normal result is to observe the limb bearing weight reappear as soon as it disappears from sight under the patient's body, as the cat corrects its centre of gravity.

Hemi-hopping (hemi-walking) and wheel-barrowing patients can be helpful in identifying subtle proprioceptive deficits. Hemi-hopping is tested by lifting the front and hind limb of a patient on one side and then pushing laterally as before. Wheel-barrowing involves lifting both thoracic limbs or both pelvic limbs and then pushing the patient forwards or backwards respectively.

2. Cranial nerve tests

A summary of cranial nerve names, numbers and functions is provided in table 1.

Number	Name	Function
I	Olfactory nerve	Perception of smell
II	Optic nerve	Sensory visual perception
III	Oculomotor nerve	Control of muscles that move the globe dorsally, ventrally and medially, elevate the upper eyelid and involved in pupillary constriction
IV	Trochlear nerve	Innervates contralateral dorsal oblique muscle responsible for inward rotation of the eyeball
V	Trigeminal nerve	Sensory innervation of the face, cornea, mucosa of nasal septum and oral cavity, and motor innervation of the masticatory muscles
VI	Abducens nerve	Innervates the ipsilateral muscles that move the globe laterally and retract the eye into the socket
VII	Facial nerve	Motor function to the muscles of facial expression and sensory function to the rostral two-thirds of the tongue and palate. Also involved in lacrimation and salivation
VIII	Vestibulocochlear nerve	Hearing and adaptation of head and body to position and movement of the head (vestibular function)
IX	Glossopharyngeal nerve	Innervates muscles of the pharynx and palatine structures. Sensory to caudal third of the tongue and pharyngeal mucosa
X	Vagus nerve	Motor function of the larynx, pharynx and oesophagus. Sensory function to larynx, pharynx and innervation of thoracic and abdominal viscera
XI	Accessory nerve	Motor function to the trapezius and some neck muscles
XII	Hypoglossal nerve	Motor innervation to the tongue

Table 1. Summary of cranial nerve names and functions.

Olfaction (CN I)

Assessment of olfaction has little clinical significance, however can be tested by bringing a small amount of strong smelling food (rather than an irritant substance) into close proximity to the cat, but out of the cat's field of vision. Ensure the cat is not able to see (or hear any sounds associated with) the food while it is brought into position. The normal response is for the cat to seek to locate the food. If the cat then eats the food this also allows assessment of gag reflex (see later). The author does not routinely perform this test due to difficulty in interpretation.

Visual tracking (CN II, CN III, CN IV, CN VI)

Visual tracking relies on a functional globe (including the retina), optic nerve, lateral geniculate nucleus, visual cortex in the forebrain and ocular motor nerves. To test visual tracking, drop cotton wool in front of your patient's eyes - the normal response is for the patient to move their eyes (with or without the head) to follow the cotton wool. If a patient is unable to visually track, pupillary light responses and ophthalmic examination can help to localise the deficit further.

Menace response (CN II, CN VII)

The menace response tests for a functional globe, optic nerve, lateral geniculate nucleus, visual and motor cortices, brainstem, cerebellum, facial nerve and facial muscles. To test the menace response, tap the patient's orbital region gently (to make them aware of the presence of a potential 'threat' of contact), then, avoiding touching hairs/whiskers or making a sudden air movement that may stimulate these, move your hand quickly towards the face and stop abruptly without making contact with the patient. The normal response is retraction of the globe, closure/blinking of the eye. Cover one eye while menacing the other to test each independently and compare for asymmetry. This is a learned response and may not be present until around 10 to 12 weeks of age in kittens. Visual function should be assessed with tracking and pupillary light reflexes (PLRs) as well as palpebral to be able to localise a lesion further within this pathway.

Pupillary light reflex (PLR) (CN II, CN III)

The presence of a normal PLR requires a functional globe, optic nerve, brainstem (oculomotor nuclei),

oculomotor nerve and muscles of the iris but does not require a functional visual cortex. To test the PLR, hold a pen-light on the midline over the nose and observe pupillary size and note any anisocoria. Then move the light source to shine in one eye only and observe for pupil constriction in this eye and the contralateral eye. Then quickly swing the light source to shine into the other eye, observe the response in each eye and then swing the light source back to the first eye. Repeat this several times in order to fully appreciate the response of each eye in turn. In the normal patient the pupil will constrict rapidly and symmetrically in the eye primarily being tested and in the contralateral eye.

Dazzle reflex (CN II, CN VII)

The dazzle reflex involves the same pathway for vision with the exception of using subcortical visual pathways rather than involving the lateral geniculate nuclei and visual cortex themselves. It is therefore useful in differentiating a cortical blindness from one originating from a different part of the visual pathway. It is tested by sudden stimulation of the eye with a very bright light source and the normal response is closing/blinking of the eye, with or without moving the head away.

Physiological nystagmus (vestibulo-ocular/ oculocephalic reflex) (CN VIII, CN III, CN IV, CN VI)

Normal physiological nystagmus (the vestibulo-ocular reflex) requires a functional vestibular portion of the vestibulocochlear nerve, brainstem, oculomotor, trochlear and abducens nerves and muscles of the globe. To test this reflex move the head side to side and then up and down. As you turn the head to the right, the normal response will be to move both eyes abruptly in that direction. This tests the abducens nerve in the right eye and the oculomotor nerve in the left eye. On moving the head back to the left this will test the abducens nerve in the left eye and the oculomotor nerve in the right eye. Only the oculomotor nerve will be tested when the head is moved vertically.

Physiological nystagmus should stop when the head is still. This can alternatively be tested by holding the cat up in front of you and rotating on the spot while observing the cat's face at eye level. Note that if the cat is spun in a circle for a length of time a post rotatory nystagmus may be observed which is not abnormal.

Positional nystagmus (CN VIII, CN III, CN IV, CN VI)

Positional nystagmus challenges the vestibular-cerebellar system further using the vestibulocochlear nerve and brainstem/cerebellum. To perform this test, place your patient in dorsal recumbency, cover the eyes, flex and extend the neck in the dorsoventral plane several times and then uncover the eyes. The normal response is to observe no evidence of nystagmus when the head is still.

Vestibular lesions should be localised to a peripheral (inner ear/vestibulocochlear nerve) or central location (brainstem or cerebellum) but the main differences are that central lesions may cause behaviour/mentation

changes and postural/tactile placement deficits where peripheral lesions do not.

Facial sensation (CN V, VII, X, 2nd cervical nerve) & nasal mucosal response (CN V ophthalmic branch)

Facial sensation involves touching the face and observing for a motor response i.e. touching the lip and looking for lip movement. Depending on where you touch will depend on which cranial nerve is assessed. Primarily it is the trigeminal nerve that is the sensory nerve with the motor nerve function provided by the facial nerve, but around the pinna the sensory innervation can be provided by the facial nerve, vagus or dorsal branch of the 2nd cervical nerve. The nasal mucosal response involves sensory receptors in the nasal mucosa, the trigeminal nerve and forebrain and is tested by covering the patient's eyes and touching the mucosa of the medial nasal septum. The normal response is moving the head away, but can be difficult to interpret in cats.

Palpebral (blink) reflex (CN V (ophthalmic or maxillary branches), CN VII)

The palpebral reflex involves the sensory receptors in the periocular skin, the trigeminal nerve, brainstem, facial nerve and facial muscles of the eyelids. To test this reflex, touch the medial/lateral canthus of the eye and observe. The normal reflex is for the patient to blink/close the eye. The medial canthus is usually more reliable than the lateral canthus for eliciting this response. If a deficit is present, the lesion should be further localised by assessing other indicators of facial and trigeminal nerve function, such as facial droop, corneal reflex and facial/nasal mucosal sensation.

Corneal reflex (CN V (ophthalmic branch), CN VII, CN VI)

The corneal reflex involves sensory receptors in the cornea, the trigeminal nerve, brainstem, facial nerve (motor to muscles for blinking) and the abducens nerve (enabling retraction of the globe).

To test this reflex very lightly touch the cornea with a soft, atraumatic material such as a moistened cotton bud, taking care not to cause corneal injury. The normal response is retraction of the globe and blinking.

Gag reflex (CN IX, CN X), jaw tone (CN V) and tongue mobility (CN XII)

Deficits to these nerve functions may also be apparent in history from the owner, in particular dysphagia, regurgitation or a change in miaow. The gag reflex itself involves sensory receptors at the back of the throat, the glossopharyngeal and vagus nerves (both sensory and motor pathways) and the brainstem. Jaw tone involves the associated local musculature, trigeminal nerve, NMJ (neuromuscular junction) and brainstem. Tongue muscle symmetry and movement is also controlled by the neuromuscular system (musculature, hypoglossal nerve (CN XII) and NMJ) and brainstem. Assessment of the gag reflex, jaw tone and tongue tone can be done concurrently. To test the gag reflex, gently open the

mouth, (assess jaw tone and observe the tongue) and then insert your finger into the oropharynx and immediately withdraw. The normal response is jaw tone/resistance to opening the mouth, closure of the larynx, glottis and contraction of the oropharynx and subsequent licking/tongue movement. Observing the patient eating is also a useful method of assessing the gag reflex, although take care with regard to aspiration if you think this may be decreased.

3. Spinal Reflexes

The purpose of performing spinal reflex tests is to differentiate whether reflexes are normal, LMN or UMN, which (in conjunction with gait, posture and postural reaction findings) allows localisation to specific regions of the spinal cord or the neuromuscular system. LMNs carry efferent information and connect the CNS (central nervous system) to the effector organ, while UMNs carry afferent information, originate in the CNS and synapse with LMNs. Assessment of muscle mass and tone should be carried out during this stage of the examination by observation, palpation and flexing/extending each limb. This allows an appreciation of the normal range of movement of the limb for this animal which will need to be taken into account e.g. when interpreting completeness of the withdrawal reflex. Limbs affected with an UMN deficit will generally have normal muscle mass with normal to increased tone and reflexes, however, chronic UMN lesions can cause loss of muscle mass as a result of mild disuse atrophy. Limbs affected with a LMN deficit will generally have normal-decreased muscle mass (depending on chronicity) with decreased to absent muscle tone and reflexes.

The most reliable spinal reflexes/responses are the femoro-patella reflex, withdrawal response, perianal reflex and cutaneous trunci reflex and only these need to be tested to localise a patient's lesion. The biceps reflex, triceps reflex and extensor carpi reflexes may also be tested (see video) but response to these is not always reliable in the cat and therefore these are not discussed further here.

Femoro-patella reflex

The femoro-patella reflex is the most reliable tendon reflex and presence or absence is the most important thing to determine. Its presence relies on an intact femoral nerve (sensory and motor components), quadriceps muscle, NMJ and the L4-L6 spinal cord segments (lumbosacral intumescence) and a lesion in any of these regions can lead to a reduced/absent reflex. An increased femoro-patella reflex can be a result of a UMN lesion cranial to the L4 spinal cord segment, but other clinical signs such as hopping deficits in the hind limbs must be present to confirm an UMN lesion. An increased femoro-patella reflex in the absence of other findings cannot be interpreted as abnormal. An increased femoro-patella reflex may also occasionally be seen with an L6-S1(2) lesion (or sciatic nerve lesion) as

a result of less tone in the counteracting, flexor muscles and therefore less opposition to extension of the limb. Cats should be given time to relax and ideally be positioned between the thighs of the clinician sitting on the floor which naturally puts the stifle in semi-flexed position. The stifle should be held loosely in partial flexion and the patellar ligament gently tapped with a patella hammer (or handle of artery forceps). The normal response should be appropriate extension of the limb at the stifle.

Withdrawal response

The withdrawal response consists of three separate components: 1. flexion of all joints as indication of a positive withdrawal reflex, 2. a conscious pain response and 3. The presence/absence of a crossed extensor reflex. The withdrawal reflex is the most reliable spinal reflex and is separate from the ability to feel pain or the crossed extensor reflex.

To assess the withdrawal response your patient should be relaxed and ideally in lateral recumbency (although again you can do this whilst cradling the cat on its back). Have the limb being tested uppermost and gently extended, and then apply increasing pressure to a digit (usually digit 5, as in the hindlimb sensory information from digits 1 and 2 may travel via the femoral nerve +/- the sciatic.) Digital pressure may be enough to elicit withdrawal, but if not, you may need to use forceps across bone of digits. A normal withdrawal reflex is flexion of all the joints with sufficient force (including the hock/tarsus and digits), taking into account the normal range of movement for the individual patient. In the hind limb, this reflex relies on lumbar nerve roots (L1-4), the femoral nerve (L4-L6) for flexion of the hip and sciatic nerve (L6-S1/2) for flexion of the stifle and hock/digits. In the forelimb, it relies on the median, ulnar, musculocutaneous, radial and axillary nerves (C6-T2). Both also involve functional relevant fore and hindlimb muscles, NMJ, nerve root and spinal cord segments at each intumescence. A cat should not normally kick out or vocalise before completing the movement - this usually indicates a deficiency.

Assess for conscious pain response (e.g. turning, trying to bite or vocalising) whilst applying force to the digit. NB the pain response is different from the withdrawal reflex. Lack of deep pain is a poor prognostic indicator. If a cat can move its limbs voluntarily pain perception is usually intact (unless a purely sensory deficit exists) and you may want to avoid testing this.

The presence of a crossed extensor reflex indicates an UMN lesion to the intumescence tested, but is a weak sign if found in isolation. Crossed extensor reflexes should be assessed after performing the withdrawal reflex when the uppermost limb is in its fully flexed position. Take the dependent limb (which should be extended at this point) and apply pressure to the 5th digit. A crossed extensor is present if the uppermost limb extends rigidly as the dependent limb flexes.

Perianal reflex

This reflex relies on the intact perianal muscles, pudendal nerve (S1-S3), NMJ, caudal nerves and their associated spinal cord segments.

Assess tail movement and muscle tone. The perianal reflex is assessed by lightly applying pressure to the anus or perianal skin. The normal response should be tail flexion with anal sphincter contraction. It is important to check anal tone at this stage. This is best done with forceps in cats - you should not be able to open the forceps easily if tone is normal.

Tail pull injuries/trauma are common in cats and commonly affect the sacral nerves/S1-S3 spinal segments. Assessment of bladder size, tone and ease of expression is useful to help decide if there is a LMN bladder problem.

Cutaneous trunci (panniculus) reflex

This reflex can be extremely difficult to elicit/unreliable in cats, but involves sensory receptors in the skin, their associated peripheral nerves, spinal cord segments C8-T1, the lateral thoracic nerve (motor), NMJ and cutaneous trunci muscle. An absent reflex may have no implication without other clinical signs of disease in that localisation. This reflex is particularly helpful in localising a T3-L3 lesion or C8-T1 lesion (i.e. brachial plexus injuries). T3-L3 lesions do not all have a cutaneous trunci cut off but if found it can support evidence that the lesion is there.

To test this reflex, starting at the level of the L5 vertebral body (approximately level with the cranial edge of the wings of the ileum, just lateral to the dorsal spinous processes) pinch the skin with forceps/pluck some hairs on the dorsum and observe for the normal response of contraction of the cutaneous trunci muscle causing a twitch of the flank. If the reflex is present at L5 you do not need to test further dermatomes, unless looking for a sensory arm deficit. If absent, working cranially, continue to pinch the skin one vertebrae cranially at a time assess for a response.

4. Examine your patient for spinal pain

Apply dorsal and transverse pressure to each vertebra in turn along the whole length of the spine and perform lateral and dorsoventral flexion of the neck, whilst observing for a response that may indicate pain (i.e. trying to bite, vocalising etc). Pain is a poor localiser given the number of anatomical structures present that could cause pain in any given area, but the presence of pain may act as a supportive indicator of a lesion.

To see a video of a neurological exam being performed, please go to www.langfordvets.co.uk/small-animal-hospital/feline-centre/feline-update and click on the 'videos' link.

COMPLETED NEUROLOGICAL EXAMINATION - WHAT NEXT?

Having completed the neurological exam the information should then be reviewed to decide if the problem is neurological and if so, where the lesion localises to. Having localised your lesion, knowledge about onset, progression, response to medication etc. should be used in combination with signalment and localisation to formulate a differential list of appropriate aetiological diagnoses for investigation with appropriate diagnostic tests.

Neurological conditions are commonly classified using the mnemonic VITAMIN D (figure 1).

These different categories of diseases often have similar onset, progression and severity of signs as illustrated in figure 2, which will help order differentials and select diagnostics appropriately. Consultation of a comprehensive text, such as the BSAVA Manual of Neurology, is recommended as a source of further information.

- V** – Vascular
- I** – Inflammatory/infectious
- T** – Traumatic/toxic
- A** – Anomalous
- M** – Metabolic
- I** – Idiopathic
- N** – Neoplastic, Nutritional
- D** – Degenerative/ developmental

Fig 1. – 'Vitamin D' mnemonic for classification of neurological conditions.

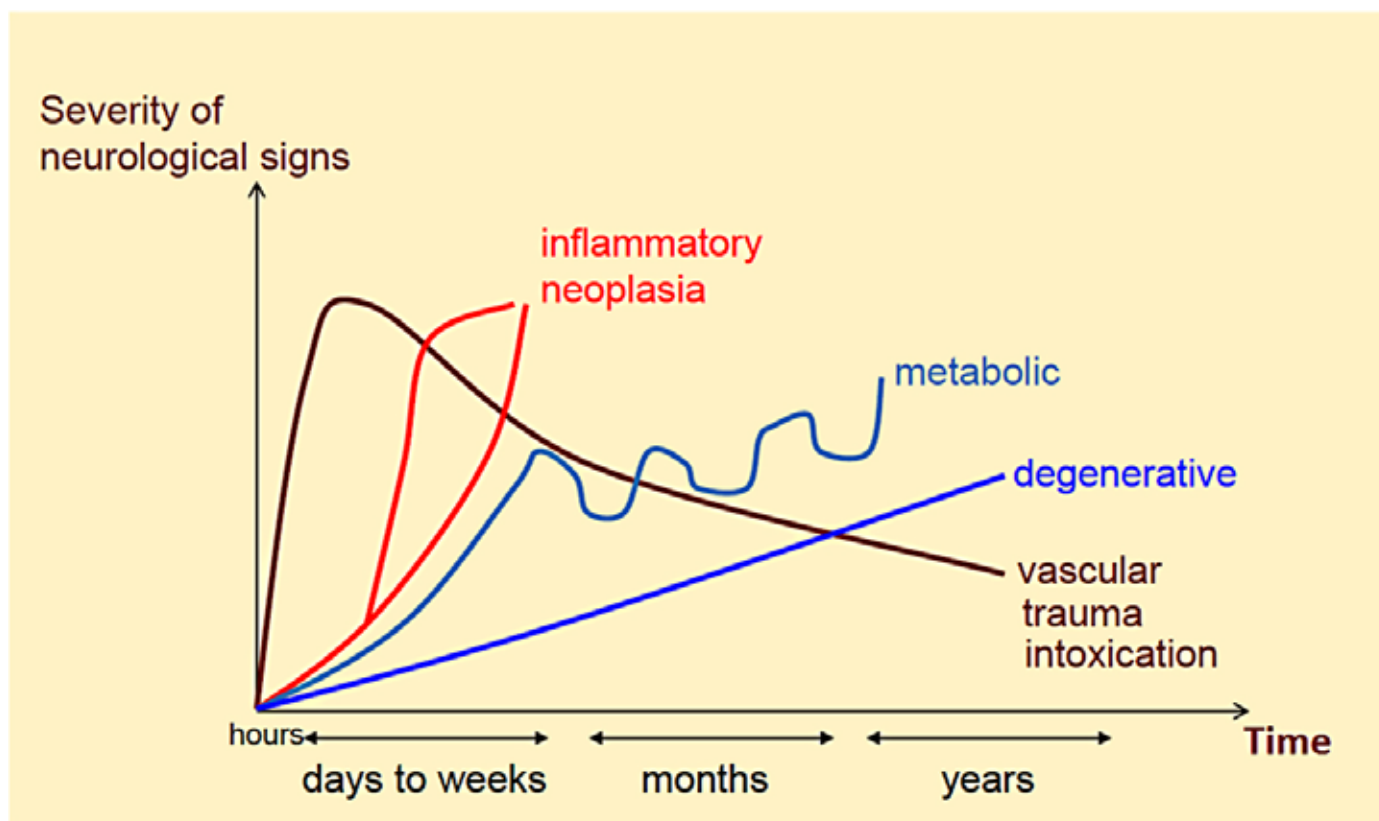


Fig 2. Onset and progression of neurological diseases of various causes.
(Courtesy of Dr Nicolas Granger DVM PhD Dip ECVN MRCVS).

References

- BSAVA *Manual of Canine and Feline Neurology* (2013) BSAVA
Eds S. Platt & N. Olby. 4th Ed. BSAVA. Gloucestershire.
- Dewey, C. W. (2008) *A Practical Guide to Canine and Feline Neurology*, 2nd Edition. Wiley & Sons.
- De Lahunta (2008) *Veterinary Neuroanatomy and Clinical Neurology*. 3rd Ed. Saunders.