ELISABETTA MANCINELLI DVM, CertZooMed, MRCVS offers a guide to steps for conducting a neurological examination in this exotic pet species, in order to further diagnose and treat underlying conditions.

THE rabbit is now the most popular exotic animal patient in many practices, and many owners are dedicated to excellent health care for their pets.

It is of utmost importance to be able to provide these animals with the same level of care as other more common mammal species (such as dogs and cats) and give them the attention they deserve. Veterinarians must be aware of a rabbit’s anatomical and physiological parameters so when a patient is presented for illness or to have a surgical procedure performed, the special needs of these animals are met.

This eventually results in improved medical care for this species and, ultimately, in a longer and healthier lifespan.

Neurological symptoms are not uncommon in rabbits. Head tilt, circling, ataxia, paresis or paralysis, nystagmus and seizures are unfortunately frequently seen (Fisher and Carpenter, 2012). A clinical history – including details about diet, husbandry, behaviour, previous problems and in-contact animals – should always be obtained in any neurological case, followed by a thorough physical examination (Keeble 2006a).
The first aim of a neurological examination is to determine whether the problem is actually neurological. The second step is to localise the lesion anatomically – in a longitudinal and transverse plane, allowing the formulation of a list of differential diagnoses – decide which tests are to be prioritised to be able to reach a definite diagnosis and, ultimately, formulate a prognosis. Haemato-biochemistry panel, urinalysis and serology are useful in musculoskeletal cases to rule out systemic or infectious diseases, which may be responsible for the symptoms noted (Table 1).

Rabbits are prey species; they can be very nervous and frightened, and may even freeze during a neurological examination, making interpretation of findings challenging to impossible in some cases. It is important to handle them correctly to avoid further trauma and unnecessary stress.

Sedatives or tranquillisers should never be used before a neurological examination to avoid confounding results (Vernau et al, 2007).

**Examination order**

Vernau et al (2007) suggest the neurological examination in a rabbit should follow a specific order to minimise stress and reduce handling to a minimum, as it starts with manipulations that are not likely to induce pain and ends with those that either require close handling or are more likely to cause discomfort or pain to the animal (Table 2).

**General observation**

The first step includes general observation of the mental status of the animal let free to move around the examination room. This gives an indication of the rabbit’s alertness and responsiveness to the surrounding environment, or whether the animal is dull, obtunded, stuporous, unconscious or even comatose.

This will also give information regarding its posture (head and trunk) and gait (proprioception, paresis, ataxia, circling) with simple manipulations.

**Palpation, postural reactions and spinal reflexes**

Careful palpation of the bones, joints and muscles (tone, strength of muscles) should follow. Postural reactions and spinal reflexes should then be assessed.

A conscious proprioceptive abnormality indicates a neurological lesion; however, it does not localise the lesion within the nervous system as many different areas may affect these reactions.

When a paw is placed on its dorsum or the limb remains in an awkward position, sensory receptors in the muscle, joints and tendons are stimulated. The information generated by the receptors travels up the peripheral nerve, passes through the spinal cord, brainstem and thalamus to reach
the soma-to-sensory parietal cortex.

Here, the animal recognises the abnormal position. A motor impulse then flows in the opposite direction to excite the muscle necessary for correction of the abnormal placement. Normally the correction requires milliseconds, allowing a rabbit to maintain a normal upright position and bring its limbs into appropriate weight bearing position.

A series of manipulations (for example, conscious proprioceptive positioning reactions, wheelbarrow, hopping, hemiwalking, placing and righting reactions), similar to those performed in more common companion animals, can be done, but bearing in mind a normal rabbit may freeze during the examination and display conscious proprioceptive deficits in response to stress, but in absence of an actual neurological impairment.

Examination of the patellar reflex, biceps and triceps reflexes, gastrocnemius and perineal reflexes, and withdrawal reflexes should be performed with the rabbit held in a comfortable lateral position, if at all possible, allowing assessment of the sensory and motor components of the reflex arches and the descending motor pathways of the same reflexes (Vernau et al, 2007). The response should be noted as absent (0), depressed (+1), normal (+2), exaggerated (+3) and exaggerated with clonus (+4).

Especially when a brain lesion is suspected, examination of the cranial nerves is fundamental (Table 3).

Cranial nerves and sensation

Finally, sensation needs to be tested. Examination of cranial nerves, spinal reflexes and proprioceptive reactions already allowed evaluation of some sensory pathways, but perception of superficial and deep pain needs to be considered as well. However, accurate assessment and interpretation of pain perception may be extremely difficult in rabbits as they can freeze and do not show any response, even to a noxious stimulus (Keeble, 2006a).

Furthermore, simple withdrawal of the limb, after application of a noxious stimulus, may simply be indication of a segmental spinal reflex and not of a conscious pain response, which is, instead, indicated by turning of the head (Vernau et al, 2007). Loss of deep pain perception is usually sign of a poor prognosis as it results from severe damage to the spinal cord.

Further localisation approaches

Once the physical and neurological examinations have been performed, and the clinician has determined the patient has neurological problems, a few steps can help in localising further the affected area within the nervous system.

Vernau et al (2007) give, in such respect, a comprehensive discussion that helps evaluate
abnormal findings of a neurological examination. General principles used in dogs and cats apply.

Vestibular disease, in particular, is commonly seen in rabbits and may be frequently caused by *Encephalitozoon cuniculi* and/or *Pasteurella multocida* infection, but other differential diagnoses include trauma, abscess, neoplasia, vascular accident and toxoplasmosis (Harcourt-Brown, 2002).

The vestibular system should be approached by assessing the resting and positional nystagmus or strabismus, head tilt, leaning or falling to one side (Table 4).

Vestibular disease may be central and result from lesions in the cerebellum and brainstem or peripheral and is usually due to lesions in the cochlea and vestibular apparatus of the inner ear, or along the vestibular nerve (Figure 1). It may be difficult to clinically distinguish between a central or peripheral vestibular problem and, often, a definitive diagnosis can only be achieved postmortem with histological examination of inner ear and brain tissue (Harcourt-Brown, 2002).

In the majority of cases, pasteurellosis causes peripheral vestibular disease and infection can spread from the nasal cavity through the Eustachian tube to the middle, inner ear and vestibular tract, whereas encephalitozoonosis is responsible for central vestibular problems.

However, it has to be considered a rabbit with encephalitozoonosis may also develop pasteurellosis, further complicating the diagnosis. Serology (determination of antibody titres) and diagnostic imaging techniques may be helpful in identifying the exact problem and this is extremely important to define a prognosis and an appropriate treatment plan.

Endoscopy, microbiology, cerebrospinal fluid analysis and culture, myelography and CT (for evaluation of inner ear, skull and vertebral columns, Figure 4) may be further indicated depending on clinical and neurological examination findings (Fisher and Carpenter, 2012).

CT is particularly indicated for imaging the musculoskeletal system and detection of bone abnormalities, and MRI is a useful technique for identifying soft tissue abnormalities and enable fine detail to be visualised.

It is particularly helpful in rabbits with CNS disease as it allows soft tissue masses (for example, granuloma or tumours) and inflammatory or oedematous soft tissue changes to be detected (Keeble, 2006b).

### Therapeutic approach

Once a diagnostic plan has been laid out, all the information obtained can be used to aid decisions on the best therapeutic approach depending on the lesion/s identified (Figure 7).

Initial stabilisation and supportive care is essential in any case first presented and prior to any
diagnostic tests as many affected animals may be anorexic and/or have secondary gastrointestinal disturbances. Reducing handling and stress to a minimum is also extremely important, as well as providing adequate analgesia – even if there are no obvious signs of pain. In cases where the quality of life of the animal and its welfare are significantly compromised, euthanasia should be considered.

References

Figure 1. Head tilt in rabbits may be indication of a central or peripheral vestibular problem.
Figure 2. Latero-lateral radiograph of a rabbit presented for hindlimb paralysis showing vertebral luxation between T10 to T11.
Figure 3. Latero-lateral radiograph of the same case as Figure 2 showing marked lytic and proliferative bony changes associated with L3 to L4.
**Figure 4.** CT image of a rabbit showing both tympanic bullae completely filled with purulent material.
Figure 5. CT image of a rabbit showing discospondylitis of L3 to L4 with associated abscess formation and severe extradural spinal cord compression.
<table>
<thead>
<tr>
<th>Systemic disease</th>
<th>Causes</th>
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| Metabolic        | Renal failure  
                  | Hepatic encephalopathy  
                  | Electrolyte imbalances (such as hypokalaemia)  
                  | Pregnancy toxaemia |
| Infectious       | Pasteurella multocida  
                  | Encephalitozoon cuniculi  
                  | Toxoplasma gondii  
                  | Listeria monocytogenes  
                  | Herpes simplex virus type one |
| Toxic            | Lead  
                  | Fipronil  
                  | Pyrethrin/permethrin |
| Neoplastic       | Lymphoma |

Table 1. List of common systemic diseases that may be responsible for neurological symptoms in rabbits (Keeble, 2006b; Fisher and Carpenter, 2012)
<table>
<thead>
<tr>
<th>General observation (mental status, posture, gait)</th>
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<tbody>
<tr>
<td>Palpation</td>
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<tr>
<td>Postural reactions</td>
</tr>
<tr>
<td>Spinal reflexes</td>
</tr>
<tr>
<td>Cranial nerves</td>
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<tr>
<td>Sensation</td>
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</tbody>
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Table 2. Recommended order of neurological examination in rabbits (modified from Vernau et al, 2007)
<table>
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<tr>
<th>Cranial nerve</th>
<th>Function test</th>
<th>Useful in rabbits?</th>
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<tbody>
<tr>
<td>CN I (olfactory)</td>
<td>Response to noxious odour</td>
<td>Difficult to evaluate, not routinely performed</td>
</tr>
<tr>
<td>CN II (optic)</td>
<td>Menace response, Pupillary light reflexes (PLR), Visual placing reactions</td>
<td>Often they do not blink in response to a menace gesture</td>
</tr>
<tr>
<td>CN III (oculomotor)</td>
<td>Pupillary size and symmetry, PLR (direct), Consensual</td>
<td></td>
</tr>
<tr>
<td>CN IV (trochlear)</td>
<td>As for CN III (strabismus, resting nystagmus, corneal reflex, pupillary size)</td>
<td>The physiological nystagmus is seen with head movements</td>
</tr>
<tr>
<td>CN V (trigeminal): motor function (mandibular nerve)</td>
<td>Atrophy of masticatory muscles, Jaw tone</td>
<td>It may be difficult to assess the jaw tone</td>
</tr>
<tr>
<td>CN V (trigeminal): sensory function</td>
<td>Corneal reflex, Palpebral reflex, Facial skin and lip pinching</td>
<td></td>
</tr>
<tr>
<td>CN VI (abducent)</td>
<td>Examine for strabismus, resting nystagmus, corneal reflex</td>
<td></td>
</tr>
<tr>
<td>CN VII (facial)</td>
<td>Facial symmetry, Palpebral reflex, Blinking and ear movement</td>
<td></td>
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<tr>
<td>CN VIII (vestibulocochlear)</td>
<td>Response to sudden noise, Nystagmus induced by head movement, head tilt, ataxia, strabismus</td>
<td>Hearing loss may be difficult to evaluate clinically</td>
</tr>
<tr>
<td>CN IX (glossopharyngeal), X (vagus) and XI (accessory)</td>
<td>Observation of swallowing, Gag reflex</td>
<td>Difficult in nervous rabbits, Gag reflex not done in rabbits because of the anatomy of their oral cavity, Assessment of XI is difficult</td>
</tr>
<tr>
<td>CN X (vagus)</td>
<td>Swallowing reflex, Oculocardiac reflex</td>
<td></td>
</tr>
<tr>
<td>CN XII (hypoglossal)</td>
<td>Tongue movement and strength</td>
<td>Difficult to grasp the tongue</td>
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Table 3. Assessment of cranial nerve function (modified from Keeble, 2006b)