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Behaviour

Neurological disease and behaviour
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Introduction
In this lecture I will discuss the general approach to investigating behavioural cases that may have a neurological component, using specific conditions such as epilepsy and syringomyelia as examples.

Neurological structures are the platform for the information storage, retrieval and processing systems that are the basis for all behaviour. It is no surprise that neurological disease can lead to behavioural problems, or that research into behavioural and psychiatric problems is demonstrating their intrinsic biological basis.

The ability to adapt is a critical property of biological systems, and behaviour is the main adaptive output of the central nervous system. The individual’s current behaviour is the product of the balance between different motivations that arise out of the individual’s need to maintain itself, defend itself and reproduce. Motivational states change the animal’s priorities, so that, for example, hunger will bias priorities and behaviour in favour of hunting, food finding, eating and defending food against others. Likewise, pain will bias towards self-defensiveness and avoidance.

Neurological disease can therefore affect behaviour in a number of ways:
- Alteration of motivations/priorities (increased defensiveness, changes in appetite/thirst etc).
- Impairment of cognition, perception, or ability to respond to situations.
- General response to illness (inhibition, withdrawal and avoidance).

In addition, central neurological disease can directly affect the specific function of brain regions, and thereby the patterns of responses that they are able to generate.

Indicators that disease may underlie a behaviour problem
- A developmental course that is at odds with the environment.
- Sudden change in behaviour/personality in an adult dog.
- Presence of concurrent medical or neurological signs.
- Bizarre or grossly disorganised patterns of behaviour.
- Signs of cognitive function deficits (dementia).

A healthy animal should follow a predictable pattern of behavioural development that relates to its environment and early experience. So, we might be suspicious of disease involvement in an aggressive young dog that had a normal development, but less so in a dog that had been reared in an impoverished environment and had shown fearfulness in similar situations when younger. Personality and styles of behaviour tend to become fixed in adulthood, so that any uncharacteristic change in behaviour must always be regarded as an indication of an underlying medical problem unless it can be attributed to a specific experience.

Work up of cases
History
As the key and early features of disease may be behavioural, especially in cognitive disorder, taking the time to obtain a history is paramount. As decline with ageing develops insidiously and unnoticed, it is be appropriate to ask questions about interaction with the owner,
disorientation, sleep pattern and learned behaviour as part of a general health check up e.g. at booster vaccination or in a nurse’s “senior clinic”.

Key points to include in the history:
- Information about the animal’s development and developmental environment.
- Current signs of stress or emotional disorder.
- Age and duration of onset of signs.
- Full details of all observed behavioural changes.
- Assessment of the consistency of behavioural patterns (motor sequence, triggering stimuli, context)
- Observation of the animal’s behaviour in the clinic environment.

Whilst taking a history allow the pet to walk freely in the consulting room. For example, an animal with rostral forebrain pathology often paces round the consulting room oblivious of furniture and does not acknowledge the vet’s presence.

Clinical and neurological examination
Full clinical and neurological examinations should be performed.
From a differential diagnosis perspective the main aim is to answer the following questions:

1) If there are deficits, can these be related to disease of the forebrain?
   - Behavioural changes
   - Seizures
   - Depression/stupor
   - Circling (towards side of lesion)
   - Postural deficits (contralateral to lesion)
   - Visual deficits (contralateral to lesion, normal pupillary light responses)

2) Is there multifocal disease?
   - Deficits relating to pathology of more than one area of the nervous system suggest either an inflammatory process or a multifocal tumour such as lymphoma.
   - Vestibular disease or cranial nerve deficits suggest brain stem disease.
   - Hyperaesthesia, hypermetria or an intention tremor suggests cerebellar disease.
   - Spinal pain is typically associated with CNS inflammatory disease (and occasionally lymphoma).

Examples of neurological conditions that affect behaviour
**Cognitive function deficit (dementia)**
A cognitive function deficit suggests that the animal is unable to perceive i.e. unable to make sense of the world around it. It typically occurs in conjunction with other signs associated with damage to the limbic system especially the frontal and prefrontal cortex. There is usually a deterioration of all mental functions including memory, cognition, intellect and personality. Individuals not only lose the ability to process and learn from new information, but also lose existing memories. This makes it harder for them to cope with their environment and leads to increased anxiety and fearfulness.

**Common clinical signs:**
- *Stereotypical pacing.* The animal relentlessly and aimlessly paces, typically in the evening or night. This may be in loose circles or around the perimeter of the room. They can appear distressed and the owner typically complains that they “won’t settle”.
- *Aimless, repeated vocalisation.*
- *Excessive daytime lethargy.* The pet is disinterested in playing, going out or other previously enjoyable pursuits.
- *Decreased social interaction.* The owner no longer receives a greeting. The pet seems to exist in isolation without being part of a family.
- *Loss of learned behaviour e.g. housetraining.* The animal becomes disinhibited about defecation and urination. It is important to establish that the animal does not have
another reason for incontinence. With cognitive function deficits the animal will still posture to eliminate.

- **Fear.** The owner may describe unexplained “panic attacks” or fear of familiar situations / people.
- **Disorientation.** The animal may seem to be lost in familiar places for example unable to find a way in from the garden.
- **Other neurological deficits.** The most common are weakness, proprioceptive deficits and becoming stuck in corners and furniture because of an inability to walk backwards/avoid the obstacle. Cats stop jumping early in the disease process. Some dogs with clinical signs of cognitive function syndrome, with severe cortical atrophy, develop a central blindness or deafness.

**Epilepsy**

Underlying CNS pathology may present in the form of behavioural change in people and animals, with neurodegenerative, epileptiform, and abnormal metabolic processes underlying behavioural changes. For example, in man, epilepsy has been shown to be an underlying factor in some cases presenting as attention deficit disorder, violent behaviour, psychoses, and personality disorder [1,2,3,4,5,6,7]. In dogs, an epileptic basis has been proposed in some cases of repetitive, ritualised locomotor behaviour that have previously been characterised as stereotypical or compulsive [8] and in pathological forms of aggression [9]. Given the characteristic and epidemiological similarities between human and canine epilepsy [10] it is likely that an epileptiform basis may exist within subtypes of a range of behavioural disorders that have not yet been reliably classified.

In man, psychiatric illnesses are often comorbid with epilepsy, and certain features of personality are altered by the condition. Over the course of the illness, human patients frequently experience cognitive impairment, which in some cases may affect their ability to work.

These findings should be a strong indication that we should look for similar, but sometimes subtle, behavioural indicators in our veterinary patients.

**Syringomyelia**

Syringomyelia results in the development of fluid-containing cavities within the spinal cord due to obstruction of cerebrospinal fluid (CSF) movement [11]. One of the most common causes is Chiari malformation, which is defined as decreased caudal fossa volumewith caudal descent of the cerebellum, and often the brainstem, into the vertebral canal [12]. This common in the cavalier King Charles spaniel (CKCS). The pathogenesis of syringomyelia remains controversial.

The condition primarily presents as a behavioural problem, with affected dogs displaying an array of signs including bouts of yelping, scratching behaviour, hyperesthesia and abnormal head posture.

The precise connection between the behavioural signs and structural CNS abnormalities is not fully understood.

**References**


