Case Series

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Positioning head tilt observed in two cats with myasthenia gravis

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Abstract

Case series summary A 1-year-old castrated male domestic shorthair cat was suspected with myasthenia gravis (MG) based on neurological examination, complete blood count (CBC), serum biochemistry, radiography and electrophysiological examination. In addition, a 9-year-old spayed female domestic shorthair cat was diagnosed with MG based on neurological examination, CBC, serum biochemistry, radiography, ultrasonography and increased acetylcholine receptor antibody titre. Positioning head tilt (PHT) was observed at the time of diagnosis in both cats.

Relevance and novel information Although the pathophysiology of PHT in cats is not fully understood, the mechanism for PHT in cats with MG may be similar to that of cats with hypokalaemic myopathy, supporting our hypothesis that muscle spindle dysfunction causes PHT.

Keywords: Positioning head tilt; myasthenia gravis; myopathy; muscle spindle

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Introduction

Positioning head tilt (PHT) is a neurological sign that was first reported in 2016.[1] Animals showing signs of this condition can freely turn in any direction at will and the head is in a level position when the animal looks forward. However, the head tilts to the opposite side when the animal turns its head, and the side it tilts to changes every time the animal turns its head.[1,2] PHT has been reported in dogs with the cerebellar nodulus and uvula (NU) hypoplasia,[1] in dogs with five different types of lysosomal storage disease,[3] in one case of a dog with gliomatosis cerebri affecting NU[4–6] and in cats with hypokalaemic myopathy.[7] The mechanism for PHT can be explained by the following hypothesis: in order to maintain equilibrium of the head while moving, the vestibular nuclei contract the oblique and rectus capitis muscles bilaterally through the vestibulospinal tract based on information provided by movement from the vestibular apparatus.[1,2] The NU regulates these muscles with inhibitory outputs to achieve head equilibrium.[1,2] In order to achieve this function, the NU needs both information on head movement from the vestibular apparatus and actual head position from the proprioceptive receptor (muscle spindle) of the obliquus and rectus capitis muscles.[7] Since head equilibrium is maintained by this mechanism, PHT is caused by dysfunction of either the NU[1,3–6] or the muscle spindle of the obliquus and rectus capitis muscles.[7]

In this case series, we report on PHT seen in two cats with myasthenia gravis (MG).

Case series description

Case 1 was a 1-year-old castrated male domestic shorthair cat that was presented to the Neuro Vets Animal Neurology Clinic with decreased appetite, fatigability, decreased palpebral reflex and cervical flexion. PHT was also observed.

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Spinal reflexes were normal. The complete blood count (CBC) was within the reference interval (RI). Serum biochemistry revealed increased total protein concentration (8.2 g/dl; RI 5.7–7.8) and creatine kinase (CK) activity (410 U/l; RI <309). Hypokalaemic myopathy was excluded because the serum potassium concentration was within the RI. There were no abnormal radiography findings. Electrodiagnostic studies were performed using electromyography and evoked potential testing equipment (Neuropack MEB-9402 MB; Nihon Kohden). Premedication consisted of atropine sulphate at 0.02 mg/kg IV and propofol at 8 mg/kg IV. Anaesthesia was maintained with isoflurane (2.0%) in oxygen. Lactated Ringer's solution was administered at 5 ml/kg/h IV during the procedure. Motor and sensory nerve conduction studies for the ulnar and tibial nerves were normal. The F-wave conduction velocity and the F amplitude/maximum M amplitude were normal. During repetitive nerve stimulations derived from interosseous muscles, the amplitude attenuation was 24.3–50.6% in all four limbs. In the edrophonium test for stimulation of the left tibial nerve, the attenuation rate improved from 26.1% to 9.5% at 50 s after administration, and returned to 30.2% at 120 s, indicating a positive edrophonium test. Acetylcholine receptor (AChR) antibody titres were not measured. Based on these findings, case 1 was diagnosed with MG, although the cause of the mildly increased serum CK activity was unclear. The clinical signs, including PHT, disappeared with prednisolone treatment.

Case 2 was a 9-year-old spayed female domestic shorthair cat that was presented to the Aqua Animal Hospital with a history of an acute onset of the inability to stand and walk. A neurological examination revealed no abnormal findings. The CBC was within the RI. Serum biochemistry revealed increased alkaline phosphatase activity (134 U/l; RI 25–93). Polymyositis and hypokalaemic myopathy were excluded because serum CK activity and potassium concentration were within the RIs. A mass lesion in the cranial mediastinum and pleural effusion were observed with radiography and ultrasonography. After pleural effusion was drained and supportive care was provided, the cat became ambulatory, and cervical flexion and PHT were observed. The AChR antibody titre was 3.86 nmol/l (RI 0–0.3). Based on these findings, case 2 was diagnosed with MG, possibly due to thymoma, and treated with prednisolone and pyridostigmine bromide. Unfortunately, the pleural effusion could not be controlled, and the owner abandoned the treatment.

The PHT in cases 1 and 2 is shown in a video in the supplementary material.

Discussion

A mechanism for PHT seen in cats with hypokalaemic myopathy has been suggested.[7] Hypokalaemia causes dysfunction of muscle spindles in the cervical muscles. Because intrafusal fibres consist of skeletal muscle fibres and are affected by hypokalaemia, proprioception input from the muscles is lost, which prevents the nodules and uvula from producing inhibitory output against reflexive head tilting toward the opposite side of the head movement. More specific observations are warranted to verify whether PHT is also observed in other muscle diseases, such as muscular dystrophy and MG,[7] because the proprioceptive system deficit owing to muscle spindle dysfunction is also observed in human patients with muscular dystrophy.[8] Impaired proprioception, which can be associated with altered muscle spindle morphology in some cases, has been documented to be a secondary effect of human MG.[9] Although the pathophysiology of PHT in cats is not fully understood, its role as a mechanism for PHT in cats with MG may be similar to its role in cats with hypokalaemic myopathy, supporting our hypothesis that muscle spindle dysfunction causes PHT.

The limitations of this study include the lack of AChR testing in case 1. The AChR antibody titre is the gold standard for the diagnosis of MG and confirms the autoimmune response against AChRs. Other limitations include the small number of cases analysed and the lack of muscle pathology evaluation that included intrafusal fibres. Detailed observation of the clinical signs and course in a larger number of feline MG cases is warranted. The possibility cannot be ruled out that weakness of the cervical muscles alone may be the cause of the inability to maintain head equilibrium when the head is turned to the side. Behavioural posturing of the head to increase the visual field of view can also cause head tilting in cats with weakness, the same as PHT in feline hypokalaemic myopathy.[7]

Conclusions

This is the fifth study describing this clinical neurologic abnormality and there is still very limited information about this neurological sign. The mechanism for PHT in cats with MG in this case series may be similar to that for cats with hypokalaemic myopathy, supporting our hypothesis that muscle spindle dysfunction causes PHT. Further observations and investigation may help in determining more precisely the mechanisms for PHT with suspected involvement of muscle spindle dysfunction.

Supplementary material The following file is available online: Video 1: The first cat is case 1 and the second cat is case 2.

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Ethical approval The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

Informed consent Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

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