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Paradoxical Vestibular Syndrome Secondary to Temporal Bone Osteomyelitis and Chronic Otitis Interna in a Guinea Pig (*Cavia Porcellus*)

Abstract

A 3-year-old female intact guinea pig (*Cavia porcellus*) was presented for torticollis and ocular discharge. On examination, the guinea pig had a left head tilt with corneal ulceration and absent palpebral response of the right eye. Computed tomography showed a soft tissue attenuating mass with multifocal mineralization compressing the caudal cerebellum with moderate lysis of the calvarium. On recheck, the disease had progressed to include ataxia and proprioceptive deficits. Systemic antibiotic therapy was initiated but the guinea pig only exhibited a marginal treatment response. Due to poor quality of life, the guinea pig was euthanized. A necropsy was performed and a bony lesion was found within the skull compressing the right cerebellum and temporal lobe. Histopathology revealed suppurative osteomyelitis consistent with severe chronic bacterial otitis interna. Vestibular signs in small exotic companion mammals are a common sequela to otitis interna, often noted ipsilateral to an affected inner ear, however, in this case rare paradoxical vestibular signs were observed. Severe chronic otitis interna may result in bony lysis and proliferation capable of expanding from the inner ear resulting in neurological deficits.

Keywords

Guinea pig, *Cavia porcellus*, Abscess, Cerebellum, Granuloma, Neurology

Disciplines

Veterinary Infectious Diseases | Veterinary Medicine | Veterinary Pathology and Pathobiology

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Brief Communication**Paradoxical Vestibular Syndrome Secondary to Temporal Bone Osteomyelitis and Chronic Otitis Interna in a Guinea Pig (*Cavia Porcellus*)**

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Abstract

A 3-year-old female intact guinea pig (*Cavia porcellus*) was presented for torticollis and ocular discharge. On examination, the guinea pig had a left head tilt with corneal ulceration and absent palpebral response of the right eye. Computed tomography showed a soft tissue attenuating mass with multifocal mineralization compressing the caudal cerebellum with moderate lysis of the calvarium. On recheck, the disease had progressed to include ataxia and proprioceptive deficits. Systemic antibiotic therapy was initiated but the guinea pig only exhibited a marginal treatment response. Due to poor quality of life, the guinea pig was euthanized. A necropsy was performed and a bony lesion was found within the skull compressing the right cerebellum and temporal lobe. Histopathology revealed suppurative osteomyelitis consistent with severe chronic bacterial otitis interna. Vestibular signs in small exotic companion mammals are a common sequela to otitis interna, often noted ipsilateral to an affected inner ear, however, in this case rare paradoxical vestibular signs were observed. Severe chronic otitis interna may result in bony lysis and proliferation capable of expanding from the inner ear resulting in neurological deficits.

Key words: guinea pig; *Cavia porcellus*; abscess; cerebellum; granuloma; neurology

A 3-year-old female intact guinea pig (*Cavia porcellus*) was presented for periocular crusts and uveitis of the right eye of one-week duration. The guinea pig was also exposed to a small dog and multiple rabbits in the household, but the patient had limited interaction with the other animals. The guinea pig was fed an appropriate diet of Timothy hay, commercial guinea pig pellets, and vegetables.

On the physical examination, uveitis of the right eye and a central corneal defect that did not uptake fluorescein stain (Bio Glo™ fluorescein sodium, HUB Pharmaceuticals, Rancho Cucamonga, CA, USA), believed to be caused by facial paresis, was diagnosed. There were proprioceptive deficits of the front and rear right limbs, yet the patient exhibited a left head tilt, ataxia and falling to the left, suggestive of paradoxical vestibular syndrome; that would localize the lesion to the vestibular tracts within the cerebellum. The guinea pig weighed 780 grams, had decreased muscle mass and prominent dorsal spinous processes. No other external abnormalities were noted during the physical examination. Further diagnostics were declined and empirical treatment of the right eye with diclofenac 1 drop, OD, twice a day for 7 days (diclofenac, 0.1% ophthalmic solution, Pack Pharmaceuticals, LLC, Buffalo Grove, IL, USA) for the uveitis and enrofloxacin 12 mg/kg orally, twice a day, for 2 weeks (Baytril, 10% solution, Bayer HealthCare, Shawnee Mission, KS, USA) for suspected intracranial extension of inner ear infection that may result in central vestibular disease.

Seven months after initial evaluation, the guinea pig was presented for recurrence of uveitis of the right eye and decreased appetite. The guinea pig had lost 110 grams of body weight. On examination, there was an absent right eye palpebral reflex along with corneal edema and anterior uveitis affecting the same eye. Fluorescein

staining of the right eye revealed a deep corneal ulcer. The guinea pig exhibited a left head tilt, falling to the left, and proprioceptive deficits of the right limbs during hopping and placing postural reaction tests. Bovine serum (1 drop, OD, q 2 h), ofloxacin ophthalmic drops 1 drop, OD, four times a day (0.3% ophthalmic solution, Falcon Pharmaceuticals, Fort Worth, TX, USA) and lubricating eye ointment (Optixcare Eye Lube, Aventix, Ontario, Canada) were prescribed and a CT scan was scheduled when the patient was to be reexamined 14 days later.

Computed tomography images of the skull were acquired with a 16-slice multidetector scanner (Aquilon 16-slice, Toshiba America Medical Systems, Tustin, CA, USA) with the patient sedated and placed in sternal recumbency (Figs. 1 & 2). Contiguous transverse images were obtained with bone and soft tissue algorithms without administration of iodinated contrast medium. Image volumes were reconstructed in three planes of variable slice thickness (0.9 mm) as well as 3D reconstructions; kVp and mAs were set at 80 and 150.

Lysis of the occipital bone was identified from the level of the right petrous temporal bone caudally to the occipital portion of the calvarium. There was slight asymmetrical thickening on the right of the petrous temporal bone. Multiple small, separate mineral features were present extending dorsally into the region of the caudal cerebrum and cerebellum from the level of the right petrous temporal bone. The right semicircular canals were not identified and were believed to have been destroyed with the osteolytic process occurring immediately dorsal. A small amount of a soft tissue/fluid attenuating material was present within the distalmost portion of the right horizontal ear

canal immediately adjacent to the tympanic membrane. Differentials at this time included neoplasia and osteomyelitis, though a primary CNS neoplasm was considered unlikely due to the presence of mineral throughout the lesion.

Following CT examination, enrofloxacin both orally (15 mg/kg, twice a day) and topically instilled into the right ear (1 drop, AD, twice a day) (Baytril Otic; Bayer HealthCare) were prescribed for inner ear infection and the apparent treatment response with the previous course of enrofloxacin. The corneal ulcer had improved shown moderate improvement therefore treatment for that condition was continued. The owner was also instructed to supplement feedings with a shredded hay support diet (Critical Care, Oxbow Animal Health, Murdock, NE, USA).

The guinea pig presented 40 days later for severe lethargy and inappetance. The guinea pig vocalized during examination, was grinding teeth at rest, and had decreased in weight to 550 grams. Left head tilt and right facial nerve paralysis were still present, and proprioception of the right forelimb and right and left hindlimbs were markedly decreased. Due to worsening pain and neurological signs, the owner elected humane euthanasia. The owner agreed to have the guinea pig submitted for a complete post mortem examination.

On necropsy, a 1 ½ cm diameter focally extensive, irregularly round, hard mass was present in the right calvarium extending from the temporal bone, and compressing adjacent temporal and occipital cerebral lobes as well as the rostral cerebellum (Fig. 3). The mass was well-adhered to the meninges and cerebrum. Histopathology of the demineralized skull mass was composed of new woven bone that encircled a focus of

marked suppurative inflammation. Inflammation and reactive bone obscured and replaced the inner ear and tympanic cavity and was contiguous with the periosteum and cerebellar meninges (Fig. 4). Within the focus of suppurative inflammation were fragments of necrotic bone. Within the cerebellum, a single protozoan cyst measuring 65 μm in diameter containing numerous 1-2 μm basophilic bradyzoites; this was considered an incidental finding and not believed to be the cause of disease.

DISCUSSION

The CT findings of lysis within the occipital bone, osseous fragments emanating out from the petrous temporal bone into the region of the caudal cerebrum and cerebellum, and loss of the right inner ear structures were most suggestive of a bacterial abscess or fungal granuloma, however, neoplasia could not be definitively ruled out. Neoplastic differentials considered included a CNS tumor such as an ossifying fibroma¹ or metastatic neoplasia. Spread of mineralization into the cerebral and cerebellar regions indicates chronicity and is not commonly associated with primary central nervous system tumors, consequently it is unlikely that neoplasia was involved with this disease process.

Computed tomography of the external and internal components of the ear allow for better delineation of osseous structures compared to radiography. Additionally, specific findings are associated with otitis that make CT a useful diagnostic test. These findings include: mineralization of the ear canal, narrowing of the canal lumen and soft tissue material within the lumen of the ear.² Otitis media is further characterized by thickening, proliferation, or lysis of the tympanic bulla. Soft tissue or fluid within the

lumen of the bulla, as well as concurrent signs of otitis externa can be expected.² Otitis interna however, is difficult to assess with CT imaging unless severe destruction of the inner ear is identified.³ As otitis interna does not produce readily apparent radiographic signs in most animals, evidence of otitis media may support a diagnosis of otitis interna, most notably in animals with peripheral vestibular signs.³⁻⁵

Abscess formation, which can be associated with severe infectious processes, is characterized by hypodense areas which represent necrotic debris. In comparison with infectious processes, neoplasia of the ear is most often associated with a soft tissue mass effect that involves the external ear canal and tympanic bulla. More severe lysis can include the petrous temporal bone and adjacent calvarium.² With severe lysis of adjacent bones the ability to definitively diagnose when evaluating images is significantly diminished, as an overlap exists between a severe infectious process and a neoplastic process, both potentially resulting in lysis and destruction of the adjacent structures.

Magnetic resonance imaging (MRI) can be utilized to characterize changes in the external, middle and inner ears,² but similar to CT, otitis interna is poorly characterized with no single pathognomonic imaging sign for the disease process. Magnetic resonance imaging was not considered an option for this patient due to patient size and prolonged anesthesia. Differentiation between an infectious and neoplastic process would require sampling, and the risk associated with bone biopsy was considered too high for this patient. Surgery was also not an option due to extensive nature of the diagnosed lesion. Identification of the causative infectious agent via culture was not performed.

This patient showed a left head tilt contralateral to the lesion location and proprioceptive deficits ipsilateral to the lesion. The expanse of the cerebellar lesion resulted in paradoxical vestibular syndrome, which requires a unilateral lesion affecting the vestibular pathways in the caudal cerebellar peduncles, cerebellar medulla, or flocculonodular lobe.⁶ It is theorized that a mass in this area will cause loss of cerebellar inhibition ipsilaterally leading to contralateral excessive discharge of vestibular neurons. The mass also resulted in brainstem compression causing vestibular ataxia and eventual facial paralysis. Cerebellar neoplasia is the most common cause of paradoxical vestibular signs, with various gliomas and meningiomas reported in canine⁷ and feline patients;⁸ similar reports in exotic companion mammals are not in the literature.

This case featured commonly observed clinical signs of vestibular disease and facial nerve paralysis. The lesion was well characterized with computed tomography, and post-mortem examination of the brain with histopathology identified suppurative osteomyelitis rather than neoplastic process. While chronic otitis interna is often implicated in vestibular disease in exotic small mammals,⁹ a sequela resulting in paradoxical vestibular signs has not been previously reported to the best of the authors' knowledge.

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Figure Legends

Figure 1. Transverse projection demonstrating the focal region of lysis of the occipital bone (white asterisk) on the right, at the level of the petrous temporal bone. The right petrous temporal bone is appreciably asymmetrically thickened (slight) compared to the left. The right inner ear was not identified and is believed to have been destroyed with the osteolytic and proliferative process occurring in the region of the petrous temporal bone.



Figure 2. 3D reconstruction demonstrating the focal region of lysis within the occipital bone immediately right of midline (arrow).

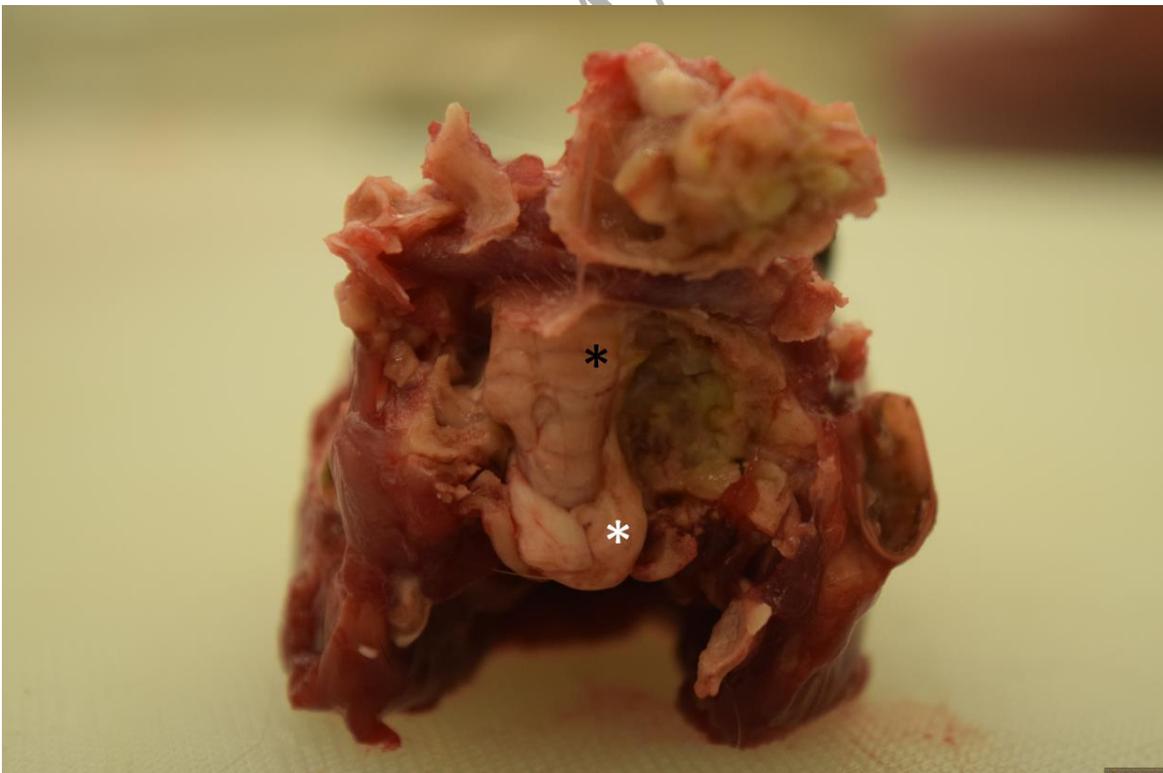


Figure 3. Dorsal aspect of the skull with sections of the occipital, parietal and temporal bones removed to reveal the mass that laterally compresses the cerebellum (black asterisk) and brain stem (white asterisk) to the left. The mass is irregularly round, measuring approximately 1.5 cm in diameter, firm and well adhered to the meninges.

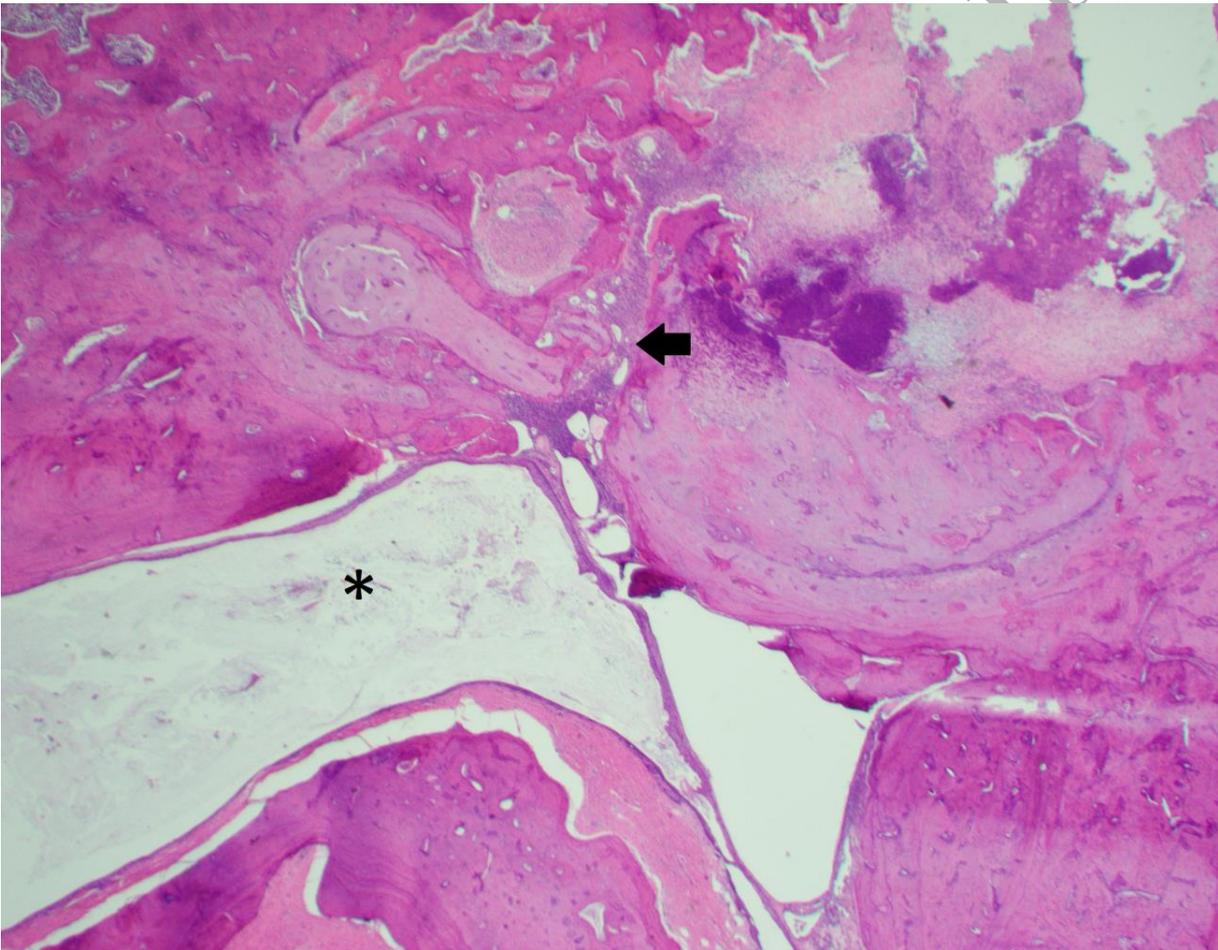


Figure 4. Section from the ear canal (black asterisk) and temporal bone. There is significant bone remodeling and heavy inflammatory infiltrates that consist of heterophils with lesser macrophages, plasma cells and lymphocytes. Plasmalymphocytic

inflammation is contiguous with the dura mater and cerebellar leptomeninges (black arrow). Bacterial organisms were not identified by light microscopy. H&E, 20X.

ACCEPTED MANUSCRIPT