



Clinical features and short-term outcome of presumptive intracranial complications associated with otitis media/interna: a multi-center retrospective study of 19 cats (2009–2017)

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- Intracranial complications: intracranial abscess or meningoencephalomyelitis uncommon sequelae associated with otitis media/interna (OMI).
- MRI or CT
 - o evidence of fluid accumulation within the tympanic cavity in conjunction with abnormalities of the adjacent intracranial structures such as meningitis, encephalitis or overt abscess formation.^{1,2}
 - o Involvement of the brain may be limited to structures adjacent to the inner ear, or may be more widespread throughout the cerebellum, brainstem and thalamocortex.
- Humans
 - o Documented pathways for spread of infection from the tympanic bulla into the cranial vault include
 - osteothrombophlebitis,
 - bone erosion due to pressure or enzymatic actions of pathogens,
 - extension through pre-formed channels or defects in the skull, or
 - hematogenous spread

Aim

- retrospective study was to provide information to enhance clinician awareness and recognition of this problem by compiling an overview of clinical features of intracranial complication of OMI in cats managed across five veterinary referral hospitals.
- In additional interest were culture results that could inform empirical antibiotic selection, as well as outcome with both medical and surgical management

Materials and methods

- Identify cats with a diagnosis of intracranial complication secondary to OMI between 2009 and 2017.
- Intracranial complications of OMI included either suppurative meningitis or intracranial abscess in association with OMI.
- Diagnosis was based on cross-sectional imaging or autopsy findings

- Presenting complaint was further categorized with respect to duration of neurologic signs prior to presentation.
 - o acute (0–48 h),
 - o subacute (3–7 days) or
 - o chronic (>7 days)
- Neurologic outcome
 - o successful in cats in which neurologic signs had improved or resolved at the time of last follow-up
 - o unsuccessful if signs were static, worsened, or if the cat was ultimately euthanized because of intracranial complications of OMI

Results

- 19 cats
- Age 2 months -13 years median 4.9 yr
- 37% (7) cats
 - o noted by owner as having previous ear infection
 - o single to multiple infections managed chronically
- 63% (12)
 - o no previous history of ear infections
- 37% cats diagnosed previously with other allergic or dermatological disease (4 with upper airway disease, cough or rhinitis 2 had food or atopy)
- Duration of neurological signs prior to presentation could be determined from the medical record in 16 cases
 - o Of these 16 cats 4 cats presented acutely (<48 hr) for the development of neurologic signs whereas 6 presented sub acutely (3-7 days)
 - In the 4/6 cats with a subacute duration of neurologic signs, systemic signs such as lethargy, decreased appetite or fever were present chronically (2 weeks to 4 months)
 - o 5 cats presented with a chronic duration of neurological signs (>7 days)
 - o 1 cat had no clinical neurological signs
- Otoscope examination
 - o Mild to moderate ceruminous discharge within the external ear canal was noted in 5 cats (33%)
 - o erythema or pronounced otic discharge suggestive of otitis externa was noted in 4 cats (27%)
 - o Tympanic membrane normal in 7 cats (47%)
 - o Abnormal of tympanic membrane were noted in 2 cats – intact but opaque the other ruptured
 - o 6 cats TM could not be visualized owing to excessive debris in external ear canal
- Neurological examination
 - o Unilateral peripheral vestibular n=3
 - o Central vestibular/rostral medulla n=9
 - o Multifocal central nervous system (rostral medulla and cerebellum or rostral medullar and thalamocortex n=6)
 - o Horner's 6 cats 33% (3 complete and 3 had partial with pupillary miosis only)
 - o Facial paralysis was not observed
 - o Decreased level of consciousness was reported in 8 cats 44%
- Laboratory

- o 7 cats nsf
- o 7 cats stress leucogram
- o 4 cats inflammatory leucogram – neutrophilia with or without left shift
- o 1 cat had a mild normocytic, normochromic non-regenerative anaemia
- o 3 cats mild to moderate hyperglobulinemia
- Imaging
 - o 5 CT and 13 MRI
 - o Unilateral (n = 11; 61%) or bilateral (n = 7; 39%) OMI was observed in all cases.
 - o CT
 - significant findings noted in addition to unilateral or bilateral OMI ranged from
 - lysis of the petrous temporal bone and meningeal enhancement within the caudal fossa adjacent to the bulla
 - one case, a contrast-enhancing mass causing displacement of the rostral medulla adjacent to the tympanic bulla
 - One cat imaged via CT had evidence of OMI but no evidence of intracranial extension noted on imaging; however, CSF revealed marked neutrophilic inflammation, and clinical signs resolved with treatment of OM
 - o MRI
 - significant findings noted in addition to unilateral or bilateral middle-ear effusion included
 - moderate or marked meningeal and/or brain-stem parenchymal enhancement adjacent to the petrous temporal bone (n = 6)
 - presence of a contrast-enhancing mass in the caudal fossa suggestive of an intracranial abscess (n = 7)
 - o CSF
 - 10 cases (53%).
 - Median total nucleated cell count was 73 cells/μl (range 1–2952/μl; normal ≤5 cells/μl)
 - median protein concentration was 30.3 mg/dl (range 11.2–267.7; normal <25 mg/dl).
 - In all 10 cases, the predominant cell type was neutrophils.
 - Cytologic evaluation described neutrophils as non-degenerate (n = 9) or non-degenerate to mildly degenerate (n = 1).
 - Bacterial or other organisms were not observed on cytology in any case
 - o Culture
 - Samples submitted were CSF (n = 3), myringotomy samples (n = 12), or from tissue or fluid samples obtained during ventral bulla osteotomy (VBO; n = 5) and one cat, a sample of fluid was obtained from the middle ear at autopsy
 - Bacterial isolates included
 - *Pasteurella multocida* (n = 4),
 - *Staphylococcus species* (n = 2),
 - *Streptococcus species* (n = 2),
 - *Actinomyces species* (n = 1),
 - *Corynebacterium species* (n = 1),
 - *Pseudomonas aeruginosa* (n = 2),
 - *Enterobacter aerogenes* (n = 1),

- *Escherichia coli* (n = 2),
 - *Clostridium perfringens* (n = 1),
 - *Peptostreptococcus species* (n = 1),
 - *Propionibacterium acnes* (n = 1) and
 - *Bacteroides vulgatus* (n = 1).
- ☐ In three cats, more than one distinct bacterial population was cultured from myringotomy fluid.
 - one cat, two different bacterial populations were cultured: one from CSF and another from fluid obtained from the middle ear
- Treatment
 - o No cats had craniotomy for surgical debridement
 - o VBO of the affected ears was performed in 12 cats
 - o 6 were managed medically
 - ☐ combination of myringotomy/ear flush and antibiotics n=3, or
 - ☐ antibiotics with no myringotomy /ear flush n=5
 - o 1 cat was euth immediately on presentation and ultimate diagnosis of OMI with intracranial complication
 - o AB choice
 - ☐ clindamycin n=9, potentiated amoxicillin/clavulanic acid n=5
 - ☐ 4 cats on more than 1 ab
 - 2 combination of clindamycin and marbofloxacin
 - 2 a combo clindamycin and ampicillin-sulbactam
 - ☐ Duration of ab variable
 - o 14 cats were prescribed steroids in conjunction with ab
 - o steroids
 - ☐ 5 cats – single anti-inflammatory dose of corticosteroids
 - 0.1-0.15 mg/kg dex sodium phosphate at time of diagnosis and not repeated
 - ☐ 4 cats received an anti-inflammatory dose of steroids for 3 days following dx
 - ☐ 5 cats received an initial anti-inflam dose of oral steroids
 - 0.5-1mg/kg/day prednisolone which was tapered over 7-14 days
 - o One cat with a large brainstem abscess originally diagnosed on CT , was managed initially with oral ab and a 3 day course of anti-inflamm steroids . One week after initial imaging CT was repeated for surgical planning of VBO and showed apparent resolution of intracranial abscess with medical treatment alone

Outcome and follow up

- Median duration of follow up for the 19 cats included in the current study was 4 months (range 0-36 months)
- Neurologic outcome was considered successful (improved or resolved) in 14 cats (74%) and unsuccessful (static or declined or euth) in 5 cats 26%
- For cats with a successful neurological outcome , median duration of follow-up was 8 weeks (range 4-36 months)
- For cats with unsuccessful outcome , median duration of follow up was 0.3 weeks (range 0-4 weeks)
- For cats that underwent VBO n=12 neurologic outcome was considered successful in 83% of cases
- For those managed medically n=6 outcome was considered successful in 66% of cases

Discussion

- Due to low prevalence but life-threatening complication of OMI it may hinder or prevent recognition of the condition in cats
 - This is particularly important given the fact that more than 63% of cats in the present study had no previous history of ear disease.
 - These results are in contrast to those reported by Sturges et al, where 8/11 cats with intracranial complications of OMI (73%) had a reported history of pre-existing ear disease.
- present study, 53% of cats lacked evidence of external or middle-ear disease on otoscope examination at the time of presentation.
- In the face of a normal otoscopic examination, a clinician may be inclined to discount otogenic complications of OMI from the list of differential diagnosis for a cat with signs of central nervous system disease; however, our results suggest this should not be the case.
- Bacterial extension from the nasopharynx to the middle ear is anecdotally a more common putative cause of OMI in cats than in dogs and therefore may explain the lack of external signs of ear disease in cats in the present study
- Most cats in the current study were presented with clinical signs referable to disease of the central vestibular system/rostral medulla with or without other signs of brain disease.
 - This is in keeping with previous veterinary studies that suggest the most common neurologic signs of intracranial complication of OMI are vestibular signs, decreased level of consciousness, paresis and seizures
 - Interestingly, a small number of cats in the current study had no clear indications that their vestibular signs were central in nature, despite ultimately being diagnosed with an intracranial complication of OMI.
 - This suggests that intracranial extension of OMI should always be considered a possibility in cats with middle-ear infection and vestibular signs, regardless of whether the signs appear peripheral or central in nature
- *P. multocida* was the most common bacteria identified, isolated in 24% of cases.
 - Ascending infection from the mouth to the middle ear via the Eustachian tube is a putative mechanism for the development of feline primary OMI.
 - This may explain the prevalence of *Pasteurella*-positive samples in the current study, as well as the lack of external ear pathology in many cases
 - there was substantial variability in the type, number and features of bacterial isolates from cats with intracranial complications of OMI.
 - ▢ These results support the recommendations of previous studies, which suggest that given the variability in culture results of cats with intracranial complications of OMI, empirical therapy with broad-spectrum antibiotic coverage for gram-positive, gram-negative, aerobic and anaerobic organisms is most rational while awaiting culture results.
- Crypts has previously been reported as a cause of OMI
- The use of corticosteroids in the management of intracranial infection in people is somewhat controversial and there are no well-controlled, randomized clinical studies evaluating their use in otogenic intracranial infection.
 - recent systematic review evaluating the use of a short course (2–4 days) of an anti-inflammatory dose of corticosteroids for bacterial meningitis in people suggests that

use was associated with fewer residual neurologic deficits and did not increase risk of adverse events

- o The rationale for the use of corticosteroids comes from experimental animal studies, which suggest that the outcome for infectious meningitis is worsened with increased severity of the inflammatory response, and that use of corticosteroids reduces the inflammatory response, decreases vasogenic brain oedema and improves outcome.
- Overall, 74% of cats in the current study had a successful neurologic outcome (defined as improved or resolved neurologic signs), regardless of whether medical or surgical management of their disease was pursued.
- Twelve of 18 cats diagnosed ante-mortem in the current study underwent VBO.
 - o Outcome in these cats was good to excellent
 - o 83% of them having improved or resolved neurologic signs at a median follow-up of 4 months after diagnosis.
- The remaining six cats were managed medically without VBO
 - o 66% of these had a successful outcome
 - o suggesting that medical management can be considered in some cases of feline OMI with intracranial extension.
 - o Follow-up was substantially shorter in the cats managed without VBO.
 - o This coupled with the retrospective nature of the study make it difficult to reliably assess the association between VBO and outcome

Conclusion

Clinical suspicion of intracranial complications of OMI should remain high in cats with central vestibular or multifocal central nervous system signs, regardless of negative findings on otoscopic examination.

Medical treatment should be based on a culture and sensitivity, given the broad range of bacterial isolates obtained from cats in the current study; however, initial antibiotic therapy should include four-quadrant coverage with special consideration for *P multocida*.

Cats with intracranial complications of OMI can have a good outcome with either surgical or medical management, and prospective studies are needed to assess the role of VBO in enhancing recovery

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CASE REPORT

Companion or pet animals

Otogenic intracranial abscessation secondary to an inflammatory polyp with chronic otitis media/interna in a cat

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- Intracranial extension of otitis media/interna (OMI) is a rare, life-threatening complication in cats and dogs.

- It is suspected to occur most commonly due to infection reaching the brainstem via the nerves and vessels of the internal acoustic meatus
- may present with a chronic (>7 days), sub-acute (3–7 days) or acute (<3days) duration of neurologic dysfunction.
- most commonly reported neurologic signs include
 - o central or peripheral vestibular signs,
 - o abnormal mentation,
 - o seizures,
 - o paresis and
 - o cranial nerve deficits;
 - o however, specific neurologic symptoms vary based on lesion location, inflammatory response and/or mass effects.
- History of pre-existing ear disease or otoscopic signs of current external or middle ear disease is only present in approximately half of the reported cases.
- This highlights the importance of considering intracranial extension of OMI in cases that present with central or peripheral vestibular dysfunction, regardless of otoscopic findings, especially when there is a history of systemic disease
- This report describes a cat with chronic OMI that resulted in cerebellar abscessation

Case presentation

- 2-year-old spayed female domestic short-haired cat presented with a 3-month history of waxing and waning lethargy, inappetence, pruritus, chronic otitis externa and left head tilt associated with an aural polyp and otitis media.
- The ear polyp was removed with traction a month prior to presentation;
- however, clinical signs worsened despite therapy
 - o oral clindamycin (3 mg/kg p.o. once daily),
 - o prednisolone (1.7 mg/kg p.o. once daily, tapered to 0.87 mg/kg p.o. every other day)
 - o enrofloxacin (3.7 mg/kg p.o. once daily),
 - o an oesophageal feeding tube was placed by the referring veterinarian for several weeks to supplement nutrition
- Upon presentation, the cat displayed a slight left-sided head tilt, mild vestibular ataxia and a thickened and bulging left ear drum.
- Treatment for otitis media/interna was initiated, including marbofloxacin (4 mg/kg p.o. once daily) and prednisolone (1.7 mg/kg p.o. once daily)
- Three days after presentation, the patient's mentation became acutely dull/obtunded with progressive neurologic deficits including marked left vestibular ataxia with left-sided proprioceptive ataxia, and vertical nystagmus induced when placed in dorsal recumbency.

Investigation

- MRI
 - o extra-axial mass along the caudal aspect of the cerebellum with a markedly contrast enhancing thickened and irregular rim,
 - o representing an intracranial abscess due to extension from left-sided OMI, with regional meningitis, cerebellar herniation and mild obstructive hydrocephalus with periventricular oedema

Differential Diagnosis

- OMI can be caused by
 - o extension of infection from the oral cavity to the middle ear via eustachian tube, which may account for the frequent isolation of *Pasteurella multocida* and cases with normal otoscopic examination.
 - o nasopharyngeal polyps,
 - o extension of chronic otitis externa and
 - o less commonly, haematogenous spread
- Reported aetiologies of intracranial abscessation or empyema include
 - o trauma or cat bites,
 - o haematogenous spread,
 - o fungal infections,
 - o extension of OMI and
 - o nasal or ocular pathology.
- In this case, the cat presented with signs of lethargy, inappetence, peripheral vestibular disease and OMI, which rapidly progressed to signs of central vestibular disease and obtunded mentation.
- Other causes of central vestibular signs need to be excluded and include
 - o other inflammatory conditions such as feline infectious peritonitis or toxoplasmosis, neoplasia or vascular diseases.
- Aside from OMI, the primary consideration for peripheral vestibular signs in cats is idiopathic vestibular syndrome.
- Based on MRI findings and the patient's rapid decline despite medical therapy, surgical debridement of the abscess was indicated. Euthanasia was elected by the owner at this time

Discussion

- treatment success has been reported for a majority of cases of intracranial complications of OMI, which commonly include meningoencephalitis, or brainstem or cerebral abscessation
- Treatments include ventral bulla osteotomy (VBO) and broad-spectrum antibiotics with or without steroid therapy
- In this case, the patient developed a cerebellar abscess, which appears to be an uncommon location for intracranial extension of OMI in feline patients.

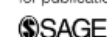
Original Article



Otoscopy and aural cytological findings in a population of rescue cats and cases in a referral small animal hospital in England and Wales

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Aim

- examine the external ear canal otoscopically and to evaluate cytological findings in a large population of cats in a non-feral environment from rescue centres, and in cats presenting to a referral Small Animal Hospital and first-opinion practice, from centres in England and Wales

Material And Method

- 341 cats
- 6 rescue centres
- Diff quick
- If there was a sufficient quantity of aural exudate present consistent with that described in *O. cynotis* infected cats, an extra sample was taken and mounted in paraffin oil on a microscope slide and a cover slip was applied. This was examined under a low power using $\times 40$ or $\times 100$ magnification and the presence of *Otodectes* or *Demodex* adult mites, or their immature life cycle stages (eggs, larvae and nymphs), was noted.
- Each stained slide examined by the same person and same microscope
- 10 fields examined

Table 1 Classification of the quantitative scale used to assess bacteria (based on a previous study)¹⁷

Classification	Description
0	No bacteria/yeast/inflammatory cells
1+	Occasional bacteria/yeast/inflammatory cells present, but slide must be scanned carefully for detection
2+	Bacteria/yeast/inflammatory cells present in low numbers but detectable rapidly without difficulties
3+	Bacteria/yeast/inflammatory cells present in larger numbers and detectable rapidly without any difficulties
4+	Massive amounts of bacteria/yeast/inflammatory cells present and detectable rapidly without difficulties

- Inflammatory cells, saprophytes, squamous cells and melanin granules were noted as being present or absent for the whole of the slide.
- If otitis (defined as aural discomfort, erythema or abnormal exudate) was noted upon otoscopy while examining a cat, cytology samples were evaluated on the same day so that medication could be prescribed
- Otoscope examination – small number examined under sedation of GA
- Scale used for otoscope scoring

Table 2 Clinical parameters and scoring system

Grade	Quantity of cerumen	Degree of ulceration	Erythema
0	None	None	None
1	Small	Mild	Mild
2	Moderate	Moderate	Moderate
3	Large	Severe	Severe

- The presence of a space-occupying lesion, such as a polyp or mass, was noted.
- Assessment also included the gross presence of *Otodectes* mites (yes/no) and whether it was possible to visualise the tympanic membrane (yes/no).
- Any other dermatological lesions (ears or whole skin) were noted.

Results

- 341 cats 3 weeks to 18 years
- 291 were reported to have contact with other cats or dogs
- 275 were indoor/outdoor cats , 45 indoor only and 20 cats life style unknown , 1 cat outdoor only
- 7.9% cats were receiving systemic therapy or topical ear medication at the time of sampling
- 15 breeds , majority were DLH 94.7%
- 8/341 2.3% of cats were noted to have focal – generalised signs of dermatological disease including moist and crusting dermatitis , abscessation, pinnae comedones, hypotrichosis of the ventrum, miliary dermatitis , chin acne, pododermatitis, paronychia over grooming and exfoliative dermatitis

Otoscope examination

- 91.2% tympanic membrane was visualised partially or completely
- 3 cats 0.9% were found to have *O. cynotis* adult mites visible extra sample was taken from 13 cats with excessive aural exudate and mounted in paraffin and examined for microscopic evidence of mites
- otoscopic and cytological findings of four cats with evidence of *Otodectes* and/or *Demodex* species. Neither bacteria nor inflammatory cells were noted.

Table 3 Cytological findings

	<i>Malassezia</i> species	Coccoid-shaped bacteria	Rod-shaped bacteria	Coccoid- and rod-shaped bacteria	<i>Otodectes cynotis</i>	<i>Demodex gato</i>	Melanin granules	Saprophytes
Number of cats with cytological findings (out of 341 cats)	62 (bilateral) 67 (unilateral)	7 (unilateral)	1 (unilateral)	1 (unilateral)	2 (bilateral) 1 (unilateral)	1 (unilateral)	212 (bilateral) 85 (unilateral)	311 (bilateral) 26 (unilateral)

Table 4 Cats with otitis and the underlying aetiology

	<i>Demodex gato</i>	<i>Otodectes cynotis</i>	Aural mass/polyp	Allergic skin disease	Ceruminous cystomatosis	Generalised skin disease	Unknown
Number of cats	1	3	3	4	2	2	24

- increased likelihood of *Malassezia* species being present with increasing age (n = 293; Pearson $r = 0.204$, $P < 0.001$)
- increased likelihood of *Malassezia* species in both ears if found within one ear (n = 327; $r = 0.499$, $P < 0.001$).
- There was a significant correlation between the number of *Malassezia* organisms and the quantity of aural exudate
- Thirty-nine cats were found to have otitis externa based on either having presented for otitis, or incidental findings upon otoscopy (aural discomfort, erythema, abnormal exudate, presence of a mass or *O. cynotis*) or *O. cynotis* visible microscopically
- A two-sided exact Mann–Whitney test showed there to be a significant difference in the number of *Malassezia* organisms per OIF between the two groups; the mean number for the otitis group was 0.687 (95% CI 0.153–1.380) vs 0.169 (95% CI 0.114–0.228) in the group of cats without clinical signs of otitis
- Bacteria were found unilaterally in 9/341 (2.6%) cats.

- o Six of these cats were in the non-otitis group and three were from the otitis group.
- o Seven of these cats had coccoid-shaped bacteria only, one cat had both rod- and coccoid-shaped bacteria and one cat had rod-shaped bacteria only.
- o Those cats with higher numbers of bacteria (3 or 4+) were within the otitis group.
- o Two of these cats (one with rod-shaped bacteria) were found to have a space-occupying lesion, documented using CT,
- Some form of ectoparasite control had been used in 278/341 (81.5%) cats at the time of enrolment into the study.
 - o Thirty-eight/341 (11.1%) cats received regular ectoparasite control at the manufacturer's recommended frequency of application.

Discussion

- Those cats presenting for otitis or with disease noted incidentally were removed when analysing the data for normal ear cytology values

Otodectes

- This study found that the prevalence of *O cynotis* was low, recorded as 0.9%.
 - o This result is in agreement with a Belgian study (2%), an Australian study (<0.1%) and a Portuguese study (2.2%).
 - o Far higher numbers were reported in a Greek study (25.5%), an Italian study (29.4%) and in a study from the USA (37%)
- An alternative method of detecting *O cynotis* infection is the use of PCR
- The prevalence may have been underestimated in this study as low-power microscopy was only performed in samples from those cats with a large amount of black or brown aural exudate on otoscopy.
 - o In a previous study, otoscopic examination was normal in eight cats that were positive microscopically (in total, 74/200 cats were found to have *Otodectes* species microscopically),
 - which suggests that all ears should have a cerumen sample taken for paraffin oil microscopy, even if otoscopy does not reveal a large amount of the classical brown/black exudate seen in *Otodectes* *ascariasis*
- Two of the three cats were found to have live *O cynotis* mites, despite having received one application of ectoparasite control (Stronghold: Selamectin and Broadline: eprinomectin, fipronil, S-methoprene and praziquantel).
 - One of these cats was a 7-week-old kitten that had received Stronghold within 4 weeks of enrolment in the study;
 - therefore, clinicians should not discount *O cynotis* based on previous acaricidal treatment alone.
- One single application of eprinomectin, fipronil, S-methoprene and praziquantel has been shown to be effective in treating otoacariasis where one treatment corresponded to 96% preventive efficacy at day 28 based on ear mite counts.
- A single application of selamectin was found to be 100% effective in resolving infestation 30 days after the treatment application in another study

Malassezia

- Cytological methods have several limitations when compared with fungal culture.

- It is a method that is readily available to clinicians and gives semi-quantitative, immediate results.
- Limitations include
 - inaccuracies in both cellular and microbial counts,
 - operator dependency and reproducibility.
 - Sometimes stain artefact was seen on slides, which could easily be misinterpreted as infection if microorganisms were incorrectly noted
- Seven species of *Malassezia* have been identified in the cat;
 - most are lipid dependent.
 - Therefore, if fungal culture alone is used to detect *Malassezia* species in feline cerumen, lipid-dependent *Malassezia* species may go undetected as many laboratories only use mycological culture media without lipids.
 - In this instance, cytology may be more sensitive in detecting yeast infection
- Despite these limitations, those cats with otitis had five times as many *Malassezia* organisms per OIF than those with normal ears.
 - The mean number for the otitis group was 0.687 (95% CI 0.153–1.380), which equates to approximately one *Malassezia* organism per two OIFs.
 - The mean number of *Malassezia* organisms per OIF was 0.169 (95% CI 0.114–0.228) in the group of cats without otitis, which equates to one *Malassezia* organism per six OIFs.
- It is important to note that some cats without clinical signs or otoscopic evidence of otitis externa had in excess of 10 *Malassezia* organisms per OIF.
 - Therefore, if *Malassezia* species are noted, this should be interpreted along with otoscopy findings and clinical signs of otitis.
 - The presence of aural *Malassezia* species in healthy cats in this study corroborated previous studies.
- One cat with *O. cynotis* and another cat with *D. gatoisolated*, were found to have >10 and 7.8 *Malassezia* organisms per OIF, respectively, which is not surprising given that it may be an opportunistic microorganism, as well as being part of the normal microflora.

Bacteria

- Two cats with large numbers (4+) of bacteria on cytology were associated with underlying aural pathology (bilateral otitis media and polyps in one cat and a unilateral aural mass in the other cat) documented using CT.
- One other cat with large numbers (4+) of bacteria unilaterally was found to have primary otitis externa and the underlying cause was not found.
- Only 6/341 cats were found to have low numbers of bacteria (1+ or 2+),
 - which is very different from previous studies, where higher numbers of cats were found to have bacteria within the external ear canal.
 - These six cats with low bacterial counts were part of the non-otitis group (n = 6/302).
- As bacteria were only noted cytologically in nine cats and two of these had a space-occupying lesion present, mean bacterial values were not calculated

Conclusion

- In this study, only a small number of cats were found to have *O. cynotis*.
- If cats present for otitis, it is important to rule out ectoparasitic disease and to consider other causes of otitis in cats including allergic skin disease (non-flea, non-food-induced feline hypersensitivity dermatitis, cutaneous adverse food reaction), and space-occupying

aural lesions such as a polyp, neoplasia and otitis media (especially in cases of bacterial otitis).

- New mean values of *Malassezia* organism counts in the external ear canals of cats were documented in this study, which may be a useful benchmark for clinicians routinely performing ear cytology in cats


Original Article



Otitis media and interna with or without polyps in cats: association between meningeal enhancement on postcontrast MRI, cerebrospinal fluid abnormalities, and clinician treatment choice and outcome

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- Otitis media and interna (OMI) has been reported to be the cause of vestibular signs in 43–63% of cats with peripheral vestibular signs (PVS).
- OMI in cats is most commonly associated with inflammation caused by upper respiratory infection that has extended through the auditory tube or a nasopharyngeal polyp.
- It occurs less frequently as a consequence of an otitis externa or neoplasia.
- Bacterial isolates from OMI include
 - *Staphylococcus* species,
 - *Streptococcus* species,
 - *Pasteurella multocida*,
 - *Escherichia coli*,
 - *Enterococcus* species and,
 - less frequently, *Mycoplasma* species, *Corynebacterium* species and other bacterial species
- Apart from bacteria, other infectious agents can be involved in cats, especially fungi (*Malassezia* species).
- Occasionally, a nasopharyngeal polyp – a non-neoplastic, inflammatory growth that arises from the middle ear or auditory tube – can be responsible for OMI.
- Diagnosis of otitis media and bacterial infection in the bulla can be achieved via cytological and/or bacterial culture of material retrieved via myringotomy or a surgical procedure such as bulla osteotomy.
- Cats with PVS are clinically recognised with the presence of at least one of the following clinical signs:

- o ipsilateral head tilt;
- o jerk nystagmus;
- o tight circling;
- o positional strabismus
- o and/or vestibular ataxia;
- o as well as the absence of any neurological signs suggestive of intracranial disease.
- o PVS reflect the involvement of the inner ear, while the presence of facial nerve deficit and/or Horner syndrome indicates involvement of the middle ear.
- MRI is a sensitive method with which to diagnose OMI, particularly for inner ear visualisation.
 - o The fluid composition of endo- and perilymph allows for good visualisation of this inner ear part in a fluid-sensitive sequence such as T2-weighted (T2W) images or in fluid-attenuated inversion recovery (FLAIR).
 - o A marked hyperintensity compared with adjacent structures is present on T2W images, while suppression is visible in FLAIR
 - o Postcontrast T1-weighted (T1W) images may show an abnormality consistent with inflammatory changes in the inner ear.
 - Typical changes raising the suspicion of OMI include isointense material in the bulla on T1W images and hyperintense on T2W images.
 - On postcontrast T1W images, a peripheral enhancement along the inner surface of the tympanic bulla can be observed.
 - A laminated appearance of the mucosa of the tympanic bulla on T2W images has also been described
 - A reduced signal intensity on T2W or an increased signal intensity on FLAIR images from the intralabyrinthine fluid is an MRI finding suggestive of otitis interna
 - o Owing to the anatomical proximity, intracranial extension of OMI can lead to a meningeal enhancement (MgE) on MRI after intra-venous administration of paramagnetic contrast medium.
 - o Anatomically, perilymph and cerebrospinal fluid (CSF) are connected via the cochlear aqueduct.
 - o Therefore, CSF analysis is another important diagnostic tool for cats with OMI and is reported to be more sensitive than MRI in identifying intracranial inflammatory processes.
 - o Thus, an abnormal MRI and/or CSF analysis can provide useful clinical information on the presence of a concurrent meningitis and may influence treatment

Aim

- to describe the association between MgE and CSF analysis results,
- their individual association with bacteriology results from affected ear samples
- the influence of the above with therapeutic choice in cats with OMI.
- hypothesised that:
 - (1) MgE is associated with CSF abnormalities;
 - (2) positive bacteriology is more common if MgE and/or CSF abnormalities are present;
 - (3) positive bacteriology is associated with the choice and length of antimicrobial and/or anti-inflammatory treatment

Materials and Methods

- Data retrospectively collected from 6 referral centres in Europe over 8 year period
- Only client owned cats with PVS that underwent MRI (with post contrast images) and CSF analysis as part of the diagnostic work up were selected
- Inclusion criteria
 1. Clinical signs consistent with peripheral vestibular lesion localisation
 2. A diagnosis of OMI with or without the presence of nasopharyngeal polyp based on MRI findings and
 3. The absence of intra axial abnormality or imaging findings consistent with empyema on MRI
- Retrospective information collected from the medical records included
 - o signalment,
 - o history,
 - o treatment prior to and after referral,
 - o right-, left-sided or bilateral PVS,
 - o MRI and CSF findings,
 - o bacteriology results from the affected ear and
 - o outcome

MRI

- Although MRI protocols varied between centres, at least T1W and T2W postcontrast images were available in all cats (gadoteric acid 0.2 mmol/kg IV [Dotarem; Guerbert Laboratories] for Bern and Hannover; gadoterate meglumine 0.1 mmol/kg IV [Dotarem; Guerbet] for RVC; gadobutrol 0.1 mmol/kg [Gadovist; Bayer] for Glasgow and Cambridge; and gadopentate dimeglumine 0.1 mmol/kg IV [Magnevist; Bayer] for Edinburgh).
- All MRIs were evaluated by a board-certified veterinary radiologist or a board-certified veterinary neurologist.
- Information about OMI with or without nasopharyngeal polyp and MgE were collected directly from MRI reports

CSF

- Abnormal CSF was defined as
 - o a total nucleated cell count (TNCC) ≥ 5 leukocytes/ μ l and/or increased total protein >0.3 g/l for cisterna magna samples and
 - o >0.45 g/l for lumbar samples.
 - o Albuminocytological dissociation was defined as an increase in total protein without an increased TNCC.
 - o Neutrophilic (respectively monocytic) pleocytosis was identified if neutrophils constituted $>70\%$ (respectively monocytes) in CSF with an abnormal TNCC

Medical Treatment

- Antimicrobials were categorised as the first or second line of treatment.
- First-line treatment included
 - o amoxicillin–clavulanic acid,
 - o cephalosporin,
 - o metronidazole,
 - o clindamycin and

- o doxycycline.
- Second-line treatment contained
 - o marbofloxacin,
 - o enrofloxacin
 - o ceftiofur
 - o pradofloxacin and
 - o cefixime.
- Anti-inflammatory drugs were categorised as steroidal (eg, prednisolone and dexamethasone) or non-steroidal (eg, meloxicam and robenacoxib).

Statistical analysis

- The presence or absence of MgE on MRI, CSF results and bacteriology culture results were compared using a χ^2 test.
- The choice of treatment based on MgE, CSF and bacteriology results were compared using a χ^2 test or a Fisher's exact test if a group contained fewer than five cats.
- Duration of treatment was compared using a Student's t-test.
- Test values were performed in a two-sided manner and a P value ≤ 0.05 was considered statistically significant.
- All analyses were performed using R version 3.6.3

Results

- 58 cats met the inclusion criteria
- DSH most common n=32
- Mean age 6.9 years (median 7.3, range 3.7mths-14.7yr)
- Clinical signs were acute (≤ 14 days) in 37 cats and chronic (>14 days) in 21 cats
- Before presentation, 32 cats were given medical treatment.
 - o Nine cases received antimicrobial treatment alone,
 - o eight had antimicrobial treatment with non-steroidal anti-inflammatory drugs (NSAIDs),
 - o nine had an antimicrobial treatment with corticosteroids,
 - o two had an antimicrobial treatment, NSAIDs and corticosteroids.
 - o Five cats received only corticosteroids and
 - o one only an NSAID.
- Forty-five cats (78%) were diagnosed with OMI alone (without a nasopharyngeal polyp)
- OMI dx
 - o 3 based on histology of material obtained from bulla osteotomy,
 - o three based on findings during bulla osteotomy,
 - o 26 based on otoscopy and cytology results obtained through myringotomy, and
 - o 13 were suspected on MRI only.
- The remaining cats (n= 13/58 [22%]) were diagnosed with OMI secondary to a polyp (Figures 3 and 4):
 - o six based on histology of material obtained from bulla osteotomy,
 - o two based on findings during bulla osteotomy,
 - o two based on otoscopy and/or cytology results obtained through myringotomy, and
 - o two were suspected on MRI only
-

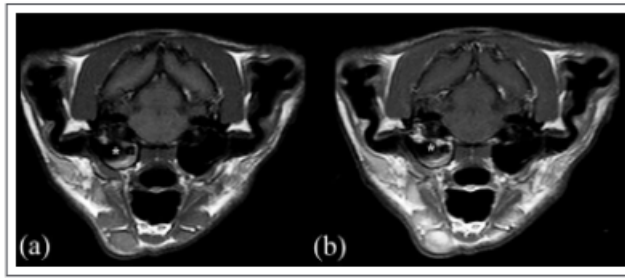


Figure 1 MRI (Philips Panorama HFO 1.0 T) transverse images in (a) T1-weighted (T1W) sequence and (b) T1W postcontrast sequence of a cat presented with otitis media interna without polyp (*) and without meningeal enhancement

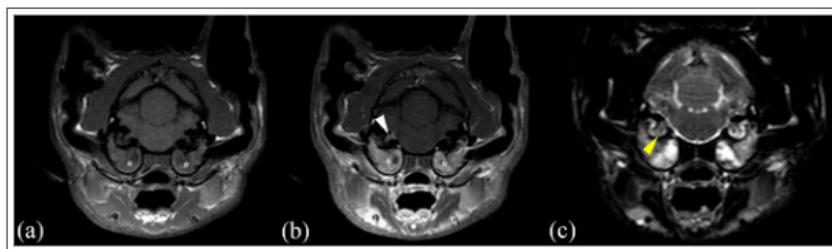


Figure 2 MRI (Philips Panorama HFO 1.0 T) transverse images in (a) T1-weighted (T1W) sequence, (b) T1W postcontrast sequence and (c) T2W sequence of a cat presented with bilateral otitis media interna without polyp (*), with meningeal and vestibulocochlear nerve enhancement (white arrowhead) and otitis interna (yellow arrowhead)

- Meningeal contrast enhancement was present in 26 cases 45%
 - o 55% did not show MgE
- CSF analysis was abnormal in 19 cats (33%):
 - o 11 with only increased TNCC,
 - ☐ five with both increased TNCC and total protein, and
 - ☐ three with albuminocytological dissociation.
 - ☐ Increased TNCC ranged between five and 1205 leukocytes/ μ l (median 12);
 - ☐ increased total protein in CSF ranged between 0.34 and 0.77 g/l (median 0.56).
 - ☐ Neutrophilic pleocytosis was seen in nine cases, mono-cytic pleocytosis was seen in one case and mixed-cell pleocytosis in six cases.
- Nine cats (16%) presented with both MgE and abnormal CSF
 - o five with only increased TNCC,
 - o two with both increased TNCC and total protein and
 - o two with albuminocytological dissociation
- MgE was detected in 17 cats (29%) with normal CSF.
- Abnormal CSF was seen in 10/32 cats (31%) without MgE:
 - o six with only increased TNCC,
 - o three with both increased TNCC and total protein, and
 - o one with albuminocytological dissociation.
- No significant association (χ^2 test, $P = 0.79$) was found between the CSF results and MgE findings

- CSF abnormalities were more statistically significantly detected more often in acute cases (n= 16/37) compared with chronic cases (n= 3/21; Fisher's test, P= 0.04),
- MgE was similar in acute (n= 15/37) and chronic (n = 11/21) cases.
- Furthermore, none of the chronic cases presented with abnormal CSF without MgE
- No association was found between the use of anti-inflammatory drugs before MRI and CSF analysis, or the presence or absence of a polyp and MgE or CSF abnormalities
- Bacterial culture was performed in 45/58 cases.
 - o Samples were collected from bulla osteotomy in 13 cases,
 - o myringotomy in 28 and
 - o the external ear canal in four.
 - o Negative bacterial culture was observed in 33/45 cases,
 - 13 (39%) received antimicrobial treatment before sampling.
 - The percentages of negative bacterial culture was 70% in acute (21/30) and 73% in chronic (n = 11/15) cases

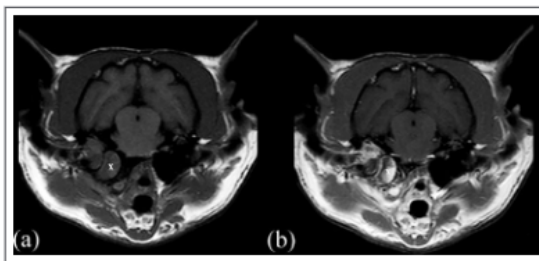


Figure 3 MRI (Philips Panorama HFO 1.0 T) transverse images in (a) T1-weighted (T1W) sequence and (b) T1W postcontrast sequence of a cat presented with otitis media interna associated with a polyp (X) and without meningeal enhancement

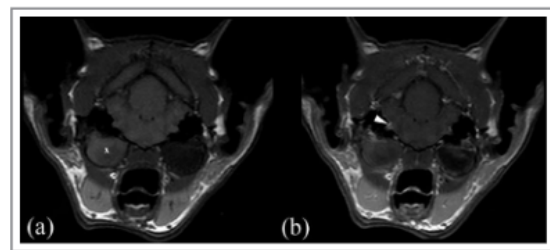


Figure 4 MRI (Philips Panorama HFO 1.0 T) transverse images in (a) T1-weighted (T1W) sequence and (b) T1W postcontrast sequence of a cat presented with otitis media interna associated with a polyp (X) and with meningeal and vestibulocochlear nerve enhancement (white arrowhead)

- Twelve cases showed a positive bacterial culture:
 - o six for *Staphylococcus species*, three for *Pasteurella species*, one for *Streptococcus canis*, one for *Actinomyces pyogenes* and one with both *Streptococcus equi subspecies zooepidemicus* and *Staphylococcus felis*.
 - o Of these, seven (58%) received antimicrobial treatment before sampling
 - No statistical association was found between a positive bacterial culture and MgE (χ^2 , P= 0.82) or CSF results
- One observation was that if no MgE was seen on MRI and no abnormality was detected on CSF analysis, the likelihood of getting a negative ear sample bacterial culture from myringotomy or bulla osteotomy was only about 12% (n= 2/17).
 - o One cat had a positive culture from CSF (*Clostridium beijerinckii* and *Enterococcus faecalis*), despite no positive bacterial culture ear sample from myringotomy and clindamycin treatment for 3 days
- Twenty-five cats received corticosteroids and 13 received NSAIDs after diagnosis.
 - o No statistically significant difference (MgE: χ^2 test, P= 0.53; CSF: Fisher's test, P= 0.08; bacteriology: Fisher's test, P= 0.62) was identified, although corticosteroids seem to have been chosen more often in the case of abnormal CSF results
- Fifty-four cats (93%) received anti-microbial treatment after diagnosis.
 - o Twenty-six of 54 (48%) had started antimicrobial treatment prior to referral,
 - o while it was started by the referral centre after diagnosis in 28 cases (52%).

- o Thirty-nine received first-line anti-microbials,
- o seven received second-line and
- o eight received both.
- o The duration of antimicrobial treatment depending on MgE, CSF or bacteriology
 - Duration of antimicrobial treatment tended to be longer in the case of positive cultures (5.58 vs 4.22 weeks) or when CSF findings were abnormal (5.83 vs 4.76 weeks), although this difference was not statistically significant (Student's t-test)
- good outcome was defined as an improvement of clinical signs (and euthanasia unrelated to the disease after several months).
- A poor outcome was defined by a lack of improvement or euthanasia.
- Although cases with MgE tended to have a poorer outcome (n = 5/18) than those without MgE (n = 3/26), the difference was not statistically significant
- No statistically significant association was found between outcome and CSF abnormalities
- Bulla osteotomy was performed in 14 cases
 - o eight with polyps and
 - o six with OMI
 - o between 1 and 78 days after diagnosis (median 5).
 - o Delayed bulla osteotomies were due to the absence of improvement or relapse of clinical signs after initial medical management.
 - o Improvement of neurological signs after surgical management was seen in 11 cases (length of follow-up varied between 1 and 104 weeks, including five cases with >8 weeks of follow-up), relapse in one (3 months postoperatively) and three cases were lost to follow-up.
 - o None of the surgical cases was euthanased for reasons related to OMI.
- Medical management resulted in improvement in 23/44 cases
 - o duration of follow-up varied between 1 and 78 months, (including 12 cases with >8 weeks of follow-up).
 - o Two cases improved and were euthanased for unrelated reasons 4 months (carcinoma) and 17 months (polyarthritis) after the diagnosis of OMI, respectively.
 - o Three cases did not improve after 1 month, but their owners declined surgery.
 - o Four cases were euthanased following diagnosis or several weeks after, with no improvement on medical treatment.
 - o One case showed intermittent vestibular signs and was euthanased 20 months after diagnosis owing to seizure-like episodes.
 - o Eleven cases were lost to follow-up

Discussion

- 58 cats with PVS diagnosed with OMI, MgE is seen in approximately 50% of cases, however only 27% of these cases had an abnormal CSF result
- There was no association between MgE and abnormal CSF results
- Chronic cases had significantly fewer abnormal CSF findings
- When a treatment was given its duration was similar regardless of a positive bacterial culture, abnormal CSF analysis of MgE
- Cases with MgE tend to have a poorer outcome
- However, only severe meningeal inflammation at necropsy was correlated with MRI findings, while mild inflammation was not detected in MRI, leading to the conclusion that the absence of meningeal enhancement does not rule out bacterial meningitis.

- Postcontrast T1W and T1W fat suppression were found to be the sequences of choice to detect meningeal inflammation
- Despite the first hypothesis that MgE is associated with abnormal CSF findings, a discrepancy between MgE and CSF results was found in 47% of cases. Indeed, MgE was seen more frequently in cases with unremarkable CSF analysis (65%), and abnormal CSF can be found without MgE in up to 31% of cases.
- In previous reports of cats diagnosed with OMI and intra-axial lesions or empyema on MRI, abnormal CSF was detected in 22/25 cases in which CSF analysis was performed.
- MgE was specifically described in one of these studies, where none of the five cats with chronic vestibular clinical signs had MgE, while all of the six acute or subacute cases did.⁷ The prevalence of MgE is in contrast with our results, in which 11/21 chronic cases and 15/35 acute cases showed MgE. When available, abnormal CSF analysis was detected in all acute or subacute cases (5/5) and only in 1/4 chronic cases.⁷ These results reflect our findings with significantly fewer CSF abnormalities in chronic cases. Previous treatment with anti-inflammatory drugs or the presence of a polyp did not affect the presence/absence of MgE or CSF results
- The second hypothesis was that there would be an association between MgE and/or CSF abnormalities and a positive bacteriology culture. In the case of absent MgE and normal CSF, the likelihood of a positive bacterial culture from myringotomy or bulla osteotomy was low (~12%). Even if this result is not statistically significant, it raises awareness in the clinician of the possible need to alter antimicrobial treatment after receiving culture results. Bacteriology results between acute or chronic cases did not differ significantly
- Finally, we hypothesised that a positive bacterial culture would influence the choice and duration of anti-microbial and/or anti-inflammatory treatment. Owing to the retrospective and multicentric aspect of our study, medical management was variable, making investigation of the final hypothesis difficult. Generally, long-term (4–8 weeks), broad-spectrum antimicrobial treatment or, ideally, a treatment based on an in vitro antimicrobial sensitivity profile, is recommended to treat OMI in cats and dogs.⁸ In this study, the duration of treatment was slightly longer in cases of positive bacterial culture than in cases of negative bacterial growth (5.58 weeks vs 4.22 weeks), although the difference was not statistically significant.
- Also, if anti-inflammatory drugs were to be implemented after abnormal CSF results, clinicians tended to use corticosteroids more frequently. These results could reflect a clinician's preference for corticosteroids in the case of central nervous system inflammation. However, clinicians need to remember the lack of CSF abnormalities in chronic cases, despite meningeal inflammation.
- Culture results from samples taken from the external ear canal have to be interpreted with caution. Common microorganisms can be detected in the tympanic bulla of healthy cats in up to 25% of cases.³² Bacteria have been previously cultured from 48% of healthy canine external ears.³³ Moreover, up to 67% of myringotomies performed via video-otoscopy might be contaminated, even if micro-organisms were detected in only 15.4% of samples.³⁴ The presence or absence of bacteria on culture should not be considered as critical in formulating a treatment plan as the type of bacteria that are cultured (ie, whether they are likely of external ear canal origin and/or possible iatrogenic contaminants vs a likely cause of middle-ear infection). The lack of a cultured infectious agent in our case series with the presumed presence of OMI raises the question of a purely inflammatory mechanism leading to otitis interna

- In this cohort, cases with identified MgE tended to have a poorer prognosis than those without MgE; however, this difference was not statistically significant, and an abnormal CSF result was not associated with any difference in outcome. This finding might help clinicians to anticipate and adapt the treatment for such cases.
- Surgical treatment with bulla osteotomy was performed in 14 cats (24%), including four in which it was performed several weeks after diagnosis. This is different to other published studies in which none of the cases with vestibular signs underwent surgery, and up to 30% of otitis media cases without neurological signs received bulla osteotomy.^{1,4} In another study focusing on OMI in cats with intracranial complications, ventral bulla osteotomy was performed more often (12/18 cases [67%]).³¹ Surgical management led to an improvement in neurological status in all cases (n = 13/13), while medical management showed an improvement in 23/31 cases (74%). These results are slightly better than those for cats with OMI and intracranial complications
- Limitations
 - o Retrospective
 - o Incomplete data
 - o Multicentre with different equipment, clinicians and protocols
 - o Clinicians may decide against CSF analyses in those cases where clear MgE is seen on MRI, biasing the population towards a higher number of cases without MgE. A similar bias could also have affected the choice of treatment in the cases included in the present study. Moreover, the use of medication prior to presentation might have affected the results. We decided to exclude all cases that presented with intra-axial lesions or empty-ema on MRI, despite presumed peripheral vestibular lesion localisation as brainstem signs may not be clinically obvious in the neurological examination and might have affected the CSF results

Conclusion

- no association was found between MgE and CSF results.
- Nearly half of cases (47%) showed a discrepancy between MRI and CSF findings.
- Additionally, the lack of MgE in MRI does not rule out the presence of a meningitis pathologically.
- Hence, CSF analysis may be useful to detect the presence of possible concurrent meningitis in cats with OMI.
- CSF findings and MgE results were not associated with the likelihood of a positive or negative middle-ear bacterial culture.
- Abnormal CSF results seemed to influence the clinicians' choice of anti-inflammatory drugs with a preference for glucocorticoids over NSAIDs.
- Abnormal CSF results were seen less frequently in chronic cases than in acute cases.
- Additionally, the identification of an abnormal CSF analysis did not seem to influence the duration of antimicrobial treatment, which remains the mainstay for this presumed infectious disease.
- Outcome tended to be poorer when MgE was detected on MRI.



Extranodal non-B, non-T-cell lymphoma with bilateral tympanic bulla involvement in a cat

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- lymphoma with tympanic bulla involvement is rare, with only three previous reports in the veterinary literature
- Here we report a unique case of extranodal lymphoma involving both tympanic bullae in a cat and causing bilateral neoplastic middle-ear effusion that initially mimicked infectious otitis media interna

Case Description

- 9YR DSH FS
- Acute onset ataxia and R head tilt
- Chronic history of recurrent otitis externa
- Indoor cat , single cat home
- Administered cefovecin and gentamicin and betamethasone , clotrimazole topical drops q12hr for 2 weeks
- presented again after 2 weeks, without improvement, following a suspected generalized seizure.
- complete blood count (CBC) were within normal limits, and serum chemistry revealed elevated total protein (9.1 g/dl; reference inter-val [RI] 5.4–8.2 g/dl), with an albumin of 4.4 g/dl (RI 2.2–4.4 g/dl) and globulins of 4.7 g/dl (RI 1.5–5.7 g/dl).
- Results of feline leukemia virus (FeLV) antigen and feline immunodeficiency virus antibody testing (SNAP FeLV/FIV Combo Test; IDEXX Laboratories) performed in August 2015 were negative.
- Cefovecin sodium injection was repeated (8 mg/kg SC once [Convenia; Zoetis]) and orbifloxacin (6 mg/kg PO q24h for 1 week [Orbax; Merck]) was initiated
- Presented to another GP for second opinion
- Physical examination revealed a vestibular ataxia and right head tilt. A large amount of fluid was visible in both external ear canals on otoscopic examination
- Radiographs showed that both tympanic bullae were thickened and irregular, and filled with soft tissue-dense material
- A more in-depth otoscopic examination revealed fluid and brown, waxy debris in the external ear canal AU
- fluid and wax were removed with suction, and both tympanic membranes were visualized and noted to be intact but thickened.
- A myringotomy was performed
 - Samples were submitted for cytology and bacterial culture.
- Cytology revealed mild mixed inflammation with neutrophils, macrophages, and rare mature lymphocytes, and a large number of bacterial cocci.
- Neoplastic cells were not identified.
- Bacterial culture grew a highly susceptible *hemolytic Staphylococcus* species.

- The cat's ataxia and head tilt improved after starting prednisone 1.3mg/kg PO q24hr and enrofloxacin 0.5%/silver sulfadiazine 1.0% emulsion (3 drops AU q12h [Baytril Otic; Bayer]) and continuing orbifloxacin as previously prescribed,
- cat continued to have daily seizures, became lethargic, stopped grooming itself and had reduced food and water intake
- Referred
- The cat was mildly obtunded with bilateral elevation of the third eyelids
- The cat had ambulatory tetraparesis with a significant vestibular and cerebellar ataxia, had a tendency to circle to the right, had a right head tilt, low head carriage, intention tremors and occasional wide head excursions to both sides.
- Cranial nerve examination revealed bilateral facial paralysis with normal facial sensation, rhythmic constriction and dilation of the pupils (hippus) in response to light in both eyes (OU), and an absent oculocephalic reflex. Menace response was normal OU, and the remainder of the cranial nerve examination was unremarkable.
- While there was bilateral elevation of the third eyelids, the cat did not appear enophthalmic or have miotic pupils (to suggest Horner's syndrome).
- Proprioception was decreased in all limbs.
- Segmental reflexes were normal.
- consistent with multifocal nervous system involvement, including bilateral central and/or peripheral vestibular, cerebellar and forebrain disease
- Results of a CBC were within normal limits, and serum chemistry revealed elevated albumin (4.1 g/dl; RI 2.5–3.5 g/dl) and total calcium (10.7 mg/dl; RI 8.4–10.1 mg/dl), most consistent with dehydration.
- The cat was hospitalized in the intensive care unit for monitoring and isotonic crystalloid fluid support (14 ml/h IV [Plasma-Lyte A; Baxter]) and was initially given levetiracetam (60 mg/kg IV once [Levetiracetam injection, USP; AuroMedics Pharma]) after a seizure.
- A loading protocol for phenobarbital was initiated (3 mg/kg IV q8h for 24 h [Phenobarbital sodium injection, USP; West-Ward Pharmaceuticals]) and later a midazolam constant rate infusion (CRI) (0.25 mg/kg/h [Midazolam injection, USP; Glaxo Pharma]) after additional seizures occurred over the next several hours.
- No additional seizures occurred after starting the midazolam CRI, and the cat's vital parameters and previous neurologic status remained static.
- The sudden deterioration in mentation just prior to anesthesia and the lack of ventilatory drive after induction were suggestive of a brain herniation event. After discussion with the owner, humane euthanasia was elected without MRI or CSF collection
- PM
 - o submandibular lymph nodes were subjectively moderately enlarged, and both tympanic bullae were filled with a soft, tan-colored material that appeared to be cerumen and suppurative exudate.
 - o A preliminary diagnosis of severe suppurative bilateral otitis media was made based on gross findings. However, histologically the soft material in both bullae was composed primarily of neoplastic lymphocytes
 - o The bullae were filled with sheets of round cells that exhibited scant-to-moderate amphiphilic cytoplasm with marked anisocytosis and moderate anisokaryosis
 - o The neoplastic lymphocytes partially effaced cranial nerves in the bullae bilaterally, and were also found in the leptomeninges, brain parenchyma, submandibular lymph nodes and pancreas, supporting a diagnosis of extranodal lymphoma
 - o Neoplastic lymphocytes labeled negative for CD3, CD18, CD20, CD45, CD79a, CD204, Pax5, cytokeratin, chromogranin and vimentin.
 - o Molecular clonality analysis with PCR for antigen receptor rearrangements (PARR) was performed using highly cellular paraffin-embedded tissue scrolls from all affected tissues. PARR failed to amplify in most tissues and was weakly polyclonal or pseudoclonal in others.

- o Based on the negative immunohistochemical labeling and PARR, and the cellular morphology, the neoplasm was diagnosed as non-B, non-T-cell lymphoma

Discussion

- A recent publication described a cholesterol granuloma associated with otitis media in a cat, which had not previously been documented in cats but is common in people
- Bulla effusion has also been found to be relatively common in cats with sinonasal disease, with some affected cats having bilateral bulla effusion.⁵ Bulla effusion in these cases is thought to be secondary to auditory tube dysfunction, and the significance of this finding is currently unknown
- Neoplasia of the middle ear is uncommon in any species and typically a result of extension from the external ear canal. Squamous cell carcinoma is the most common malignancy affecting the middle ear in dogs and cats.⁶ Lymphoma affecting the feline tympanic bullae appears to be extremely rare, with only three previously reported cases.
- Two of these cats were immunophenotyped, which confirmed T-cell lymphoma.^{2,3} One cat with T-cell lymphoma was euthanized approximately 1 week after diagnosis prior to starting radiation therapy and systemic chemotherapy,² and the other died a week after starting radiation therapy.³ In people, there are <30 cases of lymphoma of the middle ear reported in the medical literature.
- Initially presumed and eventually confirmed to have bacterial otitis media/interna that had not responded appropriately to antimicrobial therapy. Middle-ear neoplasia can result in secondary otitis media or directly mimic the common clinical signs of otitis media/interna, including aural discomfort, ipsilateral peripheral vestibular signs, facial nerve deficits and Horner's syndrome
- Thus, cases with presumed or confirmed chronic otitis media/interna that lack adequate response to antimicrobial therapy warrant further investigation to limit delay of appropriate treatment and prevent further progression of disease
- In a study of 110 cats with extranodal lymphoma, those cats that entered complete remission had a median survival of 11.2 months compared with cats with incomplete or no response having a median survival of 2 months.
- Immunohistochemical investigation of the neoplastic cells collected from multiple tissues in this case revealed that they were negative for all available B-cell, T-cell, round cell, epithelial cell and mesenchymal cell markers but were morphologically consistent with lymphocytes. Lack of clonality with PARR also supported the diagnosis of non-B, non-T-cell lymphoma

Conclusions

- Lymphoma affecting the middle ear is exceedingly rare in cats, dogs and people, and this report represents the fourth cat described with lymphoma of the middle ear.
- Although uncommon, middle-ear neoplasia should be considered in cases of middle-ear effusion, particularly when disease does not respond to appropriate antimicrobial therapy. Because of the limited number of cases and lack of attempted treatment in cats, prognosis associated with treatment for lymphoma of the feline middle ear is currently unknown

CASE REPORTS

Unilateral Laryngeal Paralysis Secondary to Otitis Media/Interna in Two Cats

Marc Kent, DVM, DACVIM (Internal Medicine, Neurology), Susan A. Arnold, DVM, Michael Perlini, DVM, Eric N. Glass, DVM, MS, Renee M. Barber, DVM, PhD

Introduction

- Laryngeal paralysis occurs infrequently in cats. Clinical signs of laryngeal paralysis in cats include dyspnea, tachypnoea, dysphonia, gagging/retching, cough, and exercise intolerance.
- Most affected cats have bilateral laryngeal paralysis.^{1,4–6}In cats with unilateral laryngeal paralysis, the left side is more commonly affected.
- In most cases, an underlying etiology is not determined and presumed idiopathic.
- Other causes include:
- A congenital disorder is presumed in cats, 2 yr old when an alternative explanation is not identified.
- Acquired causes of laryngeal paralysis in cats include
 - lymphoma of the vagus nerve,
 - mediastinal neoplasia,
 - infiltrative laryngeal neoplasia,
 - postoperative thyroidectomy,
 - cervical trauma
 - generalized neuromuscular disease
- The following case report describes unilateral laryngeal paralysis in two cats with otitis media/interna (OMI).
- In both cats, the onset of clinical signs of laryngeal paralysis shortly preceded the identification of neurological signs related to OMI including ipsilateral vestibular dysfunction and Horner syndrome.
- MRI of the head revealed extensive cellulitis of the tissues external to the tympanic bulla that extended caudally to involve the emergence of the vagus nerve from the tympano-occipital fissure

Case Report

cat 1

- 6 yr old (3.6 kg) spayed female domestic shorthair was evaluated for coughing, gagging, and Horner syndrome in the right eye (OD).
- One month prior, the cat displayed episodes of coughing and gagging.
- Three weeks later, miosis OD and protrusion of the third eyelid developed.
- Physical examination performed by the referring veterinarian was normal with the exception of Horner syndrome OD.
- The cat was prescribed robenacoxib
- Referred 1 week later
- On an awake otoscopic examination, the right tympanum was opaque and thickened.
- A ceruminolith obscured visualization of the left tympanum. Neurologically, the cat had normal mentation, gait, postural reactions, and spinal reflexes.
- Cranial nerves (CNs) were normal with the exception of Horner syndrome
- CT
 - both tympanic cavities and the left horizontal ear canal were filled with non-contrast-enhancing fluid to soft tissue-attenuating material.
 - The right tympanic bulla was enlarged and had punctate lysis and irregular periosteal proliferation.
 - In the right naso-pharynx, there was a 10.0 mmx35.0 mmx35.0 mm, soft tissue-attenuating mass that displayed peripheral contrast enhancement.
 - The neck and thorax were normal.
 - The CT findings were consistent with left-sided otitis externa and bilateral otitis media. The soft tissue mass in the nasopharynx likely was a nasopharyngeal polyp
- On laryngeal examination, there was right-sided laryngeal paralysis.
- MRI
 - T2-weighted (T2W), T2W fluid-attenuated inversion recovery, T1-weighted (T1W), and susceptibility-weighted sequences and gadopentetate IV administration
 - Bilaterally, the tympanic cavities were filled with material that was T2W-hyperintense and T1W-hypointense (right side) and T2W-hypointense and T1W-isointense (left side).
 - The material in the left tympanic cavity extended into the horizontal ear canal.

- o Bilaterally, the lining of the tympanic cavities was irregularly thickened and contrast enhancing with a nodular appearance on the right.
 - o The right tympanic bulla also was thickened. There was a 9.5 mmx33.5 mmx311mm, ovoid mass located in the right nasopharynx that was T2W-and T1W-hyperintense and displayed strong homogeneous contrast enhancement.
 - o The medial retropharyngeal lymph nodes were enlarged.
 - o Surrounding the external surface of the right tympanic bulla was T2W-hyperintense, strongly contrast-enhancing tissue that extended between the digastricus and longus capitis muscles and into the region of the opening of the tympano-occipital fissure.
 - o The MRI finding involving the fascial planes, tissue surrounding the right tympanic bulla, and the tympano-occipital fissure likely represented cellulitis.
- Cytologically
 - o the material from the left ear contained 100 cocci per $\times 100$ objective lens and the material from the right ear did not contain any observable microbes
- discharged with oral clindamycin 12.5mg/kg q12hr whilst pending culture
- culture
 - o *Staphylococcus felis* from the left ear
 - o *Pasteurella multocida* from the right ear
 - o antibiotics were changed to pradofloxacin (6.9 mg/kg orally q24 hr)
- recheck at 2 and 4 wk following discharge.
 - o episodes of coughing and gagging had resolved.
 - o The physical examination was normal without evidence of otitis externa.
 - o Neurological examination was normal other than persistent Horner syndrome OD.
 - o Based on the improvement, antibiotic therapy was continued for 8 wk.
- 2month recheck
 - o no episodes of coughing or gag-ging
 - o Physical and neurological examination were normal with the exception of mild miosis OD
 - o The previously observed right-sided laryngeal paralysis had resolved
 - o On MRI, both tympanic cavities remained filled with material but the lining of the tympanic cavities displayed less contrast enhancement. The contrast-enhancing tissue surrounding the external surface and dissection along tissue planes was no longer present. Images of the neck were normal
 - o Given the persistent material in the tympanic cavities and miosis OD, antibiotic therapy was continued for an additional 2 mo.
- At 4 mo following discharge, physical and neurological examination were normal. Antimicrobial therapy was discontinued.
- One month later, the cat underwent a comprehensive oral health assessment and treatment. At that time, there was no evidence of otitis externa, Horner syndrome OD, or laryngeal dysfunction

Cat 2

- 7yr old (5 kg) neutered male domestic shorthair
- 4 day history of lethargy and episodic falling to the left.
- The owner also noted harsher vocalizations than was normal
- Intermittently, the cat would make exaggerated swallowing attempts independent of eating or drinking
- The cat had no prior medical history including ear disease, was negative for feline leukemia virus and feline immunodeficiency virus, and was up to date on vaccination
- Referred
- Neurologically, the cat had normal mentation, gait, postural reactions, and spinal reflexes.
- CNs were normal with the exception of a left head tilt, rotatory nystagmus with fast phase directed to the right, and miosis in the left eye. Neurological signs were consistent with a lesion affecting the left peripheral vestibular system and miosis in the left eye likely due to partial loss of sympathetic innervation to the eye
- Laryngeal examination revealed left-sided laryngeal paralysis
- MRI of the head and neck as far caudal as the T3 vertebra was performed.
- MRI
 - o left tympanic cavity was filled with T2W-hyperintense material within thickening of the tympanic bulla and contrast enhancement of the tympanic cavity lining.
 - o The left medial retropharyngeal lymph node was enlarged.

- o Similar to cat 1, the tissues surrounding the external surface of the left tympanic bulla were enlarged, T2W-hyperintense, T1W-isointense, and strongly contrast enhancing.
 - o The contrast-enhancing tissue surrounding the left tympanic bulla extended into the region of the tympano-occipital fissure and also extended caudally along the course of the vago sympathetic trunk and common carotid artery to the level of the C2 vertebra.
 - o No other abnormalities were observed in the neck.
 - o The MRI findings were consistent with left-sided OMI with cellulitis
- Following recovery from anesthesia, the cat was discharged on amoxicillin-clavulanic acid_m(12.5 mg/kg per os q12 hr) for 6 wk.
- Twenty days later, physical examination remained normal and all neurological signs had resolved. T
- he owner reported return of no-mal vocalization and resolution of exaggerated swallowing attempts.
- Based on the resolution of neurological signs, the cat was discharged with instructions to complete the previously prescribed antibiotic therapy

Discussion

- In both cats, the MR findings were consistent with OMI, including material in the tympanic cavity with variable signal intensities, tympanic bulla thickening, and contrast enhancement of the lining of the tympanic cavity.^{11,12}In addition, both cats had extensive cellulitis of the tissues surrounding the tympanic bulla that extended into the tympano-occipital fissure
- Typically, neurological deficits associated with OMI include
 - o dysfunction of the facial nerve (CN VII) and the vestibulocochlear nerve (CN VIII) and Horner syndrome.
 - o The facial and vestibulocochlear nerves emerge adjacent to each other from the medulla to exit the cranial cavity via the internal acoustic meatus.
 - o Once inside the internal acoustic meatus, the facial nerve travels via the facial canal within the petrosal bone to exit the skull via the stylomastoid foramen.
 - o Along its course within the facial canal, the facial nerve is exposed to the tympanic cavity, where it is susceptible to injury
 - o Dysfunction of the facial nerve causes
 - ▢ facial paresis/paralysis resulting in lagophthalmos,
 - ▢ inability to move the pinna,
 - ▢ and a lipdroop
 - o The receptors for the vestibulocochlear nerve reside in the inner ear and provide for vestibular function and hearing. Dysfunction of the vestibulocochlear nerve results in
 - ▢ a head tilt,
 - ▢ abnormal nystagmus,
 - ▢ positional strabismus,
 - ▢ vestibular ataxia, and
 - ▢ hearing loss.
 - o Finally, the exact course the sympathetic axons take from the cranial cervical ganglion located medial to the tympanic bulla to the eye remains debated. Similar to the facial nerve, the postganglionic sympathetic axons are likely exposed to the tympanic cavity.
 - o Loss of sympathetic innervation results in Horner syndrome.
 - o The course of the facial, vestibulocochlear, and sympathetic axons relative to the middle and inner ears explain the development of the observed neurological deficits associated with OMI.
 - o Although neither had signs of facial paresis/paralysis, OMI resulted in vestibular dysfunction and/or Horner syndrome in the cats described here
 - o Laryngeal paralysis suggests dysfunction of the vagus (CN X) or its branch, the recurrent laryngeal nerve.
 - o The vagus nerve provides innervation to the striated muscles of the pharynx, larynx, oesophagus.
 - o The vagus nerve emerges from the medulla to exit the cranial cavity via the jugular foramen and ultimately exit from the skull via the tympano-occipital fissure to course caudally as the Vago sympathetic trunk.
 - o The recurrent laryngeal nerve leaves the vagus in the cranial mediastinum and courses cranial along the trachea to innervate the abductors of the larynx
 - o As the tympano-occipital fissure is located caudomedial to the tympanic bulla, the cellulitis that extended into the opening of the tympano-occipital fissure on MRI likely affected the vagus nerve in both cases.

- Other pathological processes that may cause gagging, coughing, and exaggerated swallowing attempts include glossopharyngeal nerve dysfunction or structural disease affecting the oropharynx, larynx, vago-sympathetic trunk, or recurrent laryngeal nerves in the neck.
- Laryngeal paralysis remains uncommon in cats. However, it is possible that laryngeal dysfunction may go unrecognized in cats with middle ear disease that display dysphagia or dysphonia because alternative explanations such as inflammatory polyps or pharyngeal swelling and inflammation often exist concurrently

Conclusion

- Laryngeal paralysis was identified in two cats with OMI and extensive cellulitis surrounding the tympanic bulla and the tympano-occipital fissure.
- Assessment of laryngeal function should be performed in cats with OMI that present with coughing, gagging, dysphagia, and/or dysphonia.
- Concurrent laryngeal paralysis may have an impact on the development of postoperative respiratory morbidity and mortality following VBO.
- In both cats herein, antibiotic therapy resulted in resolution of clinical signs and improved laryngeal function based on visual assessment of the larynx in cat
- Therefore, in the rare event of laryngeal paralysis secondary to OMI, antibiotic therapy may improve laryngeal function before VBO