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Pseudomonas Otitis Infection

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Pseudomonas otitis in a cocker spaniel.

PROFILE

Definition

- *Pseudomonas* otitis is an infection of the ear (**Figure 1**), most commonly with *P aeruginosa*, a motile gram-negative bacillus ubiquitous in the environment but uncommon in the canine or feline ear.
  - *P aeruginosa* grows within moist environments (eg, soil, vegetation, feces).
    - This predisposition makes infectious otitis caused by *P aeruginosa* more common in tropical climates.

Signalment

Breed Predilection

- *Pseudomonas* otitis occurs in dogs and cats.
  - Dogs with hairy, narrow canals and pendulous pinnae (eg, cocker spaniel) are predisposed to *P aeruginosa* infection.
  - No breed predilection is recognized in cats.

Age

- *Pseudomonas* spp infections occur at any age.
  - In younger patients, infection is commonly associated with allergy or ectoparasites.
    - Young cats may have nasopharyngeal polyps as underlying triggers.
  - In older patients, immunosuppression (from systemic or endocrine disease) or neoplasms of the external ear canal can increase risk.

Causes

- *Pseudomonas* spp rarely infect "normal" tissue, so causes should be identified.
  - Two studies in dogs[1,2] have suggested that primary triggers for *Pseudomonas* spp are not always evident, but infection can be associated with foreign bodies, grooming, and bathing.

Risk Factors

- At-risk factors include those that disrupt the normal environment within the ear canal and allow bacterial invasion:
  - Disruption to the physical barrier.
  - Changes affecting ventilation of the ear canal (eg, humidity, cerumen composition, temperature).
  - In dogs, conformation of the ear canal and pinna (eg, spaniels).
  - In cats, changes to otic environment; infection with nasopharyngeal polyps.
- Immune system dysfunction also is a common factor.
- Long-term use of weak antiseptics, to which *Pseudomonas* spp are inherently resistant, or chronic antibiotic use (systemic/topical) without addressing underlying disease.
- Endocrine disease (eg, hypothyroidism, hyperadrenocorticism).
- Systemic disease (eg, renal, hepatic, pancreatic disease).
- Cats with FeLV or FIV.

CONTINUES

When infection involves the middle ear, animals may show signs of otitis media or interna.

Pathophysiology

- In acute otitis, dermal edema can lead to altered barrier function and changes in cerumen composition.
  - In the canal, changes lead to increased gram-positive bacteria.
- As the lumen narrows, ventilation is reduced, environment becomes more anaerobic, and humidity and temperature increase.
  - These events lead to bacterial population of predominantly gram-negative flora, especially *Pseudomonas* spp.
- *P aeruginosa* has mechanisms for evading the host's immune response:
  - Toxins and proteases (eg, exotoxin A, lecithinase).
  - Glycocalyx "slime" helps protect *P aeruginosa* against influences from immune system and topical medication.

Signs

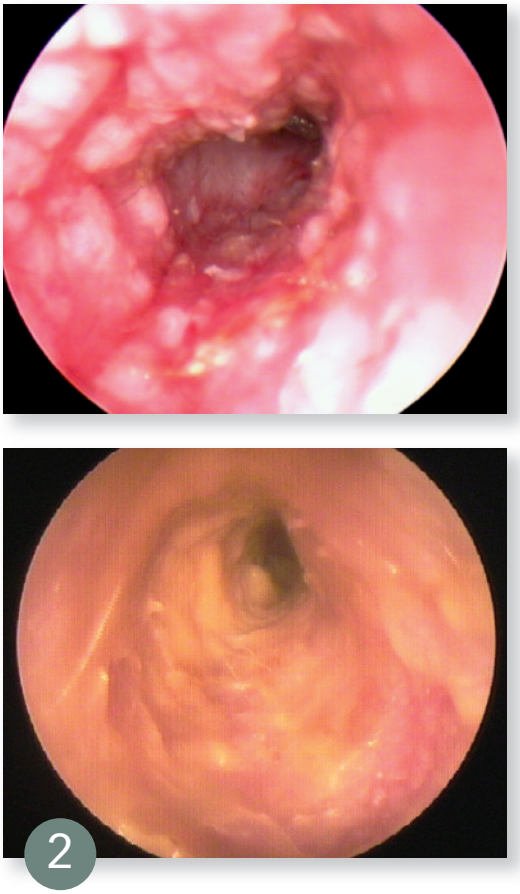
- Otic infection with *Pseudomonas* spp is usually a unilateral disease with acute onset.
- Animals typically present with head shaking or ear scratching.
- Infected ear pinna is commonly inflamed and often ulcerated.
- Otic discharge, which can extend onto the concave aspect of the ear pinna, is usually mucoid, malodorous, and yellow/green.

History

- The first sign owners usually notice is malodorous discharge.
- Owners may also report signs of neurologic damage (eg, Horner syndrome, facial nerve paralysis):
  - Motor nerve damage appears as facial asymmetry.
  - Parasympathetic nerve damage may appear as keratoconjunctivitis sicca.
- Animals may have problems chewing hard food, barking, or carrying objects.
- With otitis interna, owners may report hearing loss, head tilt, or nystagmus.

Physical Examination

- Patients usually resent ear examination.
  - Their ears are painful rather than pruritic.
- The ear canal is swollen, ulcerated (**Figure 2**), and uncomfortable with malodorous, often hemorrhagic yellow/green mucopurulent discharge.
- The tympanum may or may not be intact.
  - It can remain intact while the middle ear is infected but will appear abnormal (eg, bulging, hemorrhagic, dark [brown/gray] with visible exudate behind it).
- When infection involves the middle ear, animals may show signs of otitis media or interna.
  - Otitis media (with/without tympanic rupture) is reported in ~83% of chronic otitis externa cases.[7]



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Video otoscope images of an ulcerated, erythematous, inflamed ear in a dog with *Pseudomonas* infection.

Pain Index

- The density of nerve endings increases with ear depth.
- Although inflammation and ulceration commonly extend from pinna into middle ear, involvement of horizontal canal and middle ear contributes to severe pain.
  - This makes adjunct analgesia important.

DIAGNOSIS

Definitive Diagnosis

- Infected pinnae are typically erythematous, ulcerated, and covered in thick yellow/green mucoid discharge.
- Otoscopic examination (may require sedation/anesthesia) reveals further inflammation and ulceration of the canal, which is often swollen and partially occluded.
  - Discharge in the canal is similar to that on the pinna but often is hemorrhagic.

Differential Diagnosis

- Underlying causes can vary and trigger factors should be thoroughly investigated.
  - Factors may include concurrent systemic disease, inappropriate therapy, or changes to the ear canal's microclimate.

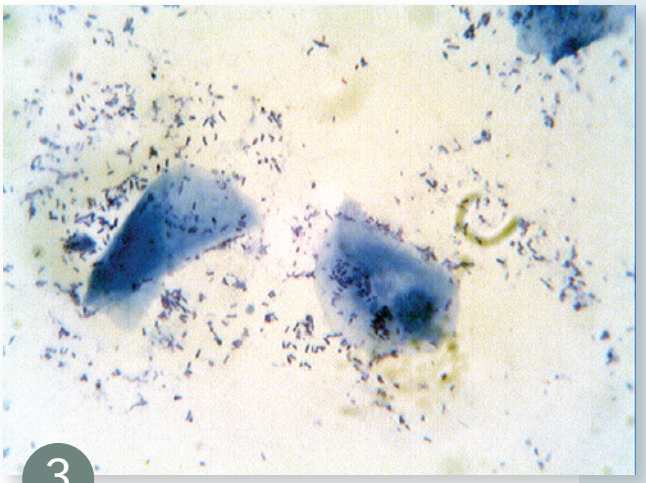
Laboratory Findings

Cytology

- Samples of otic exudates should be stained with Gram or modified Wright's-Giemsa stain.
  - *P aeruginosa* appears as rod-shaped organisms, typically accompanied by degenerate neutrophils (**Figure 3**).
  - Rod bacteria on cytology samples of otic exudates should undergo culture and antibiotic sensitivity testing.

Cultures

- Samples for cytology should be obtained from the junction of vertical and horizontal canals.
  - In cases of suspected otitis media, samples from the middle ear are needed.
    - Samples of bacteria can be obtained with guarded technique by passing a sterile swab or syringe attached to a 4-5 French gauge catheter (through which 0.5 mL of sterile saline can be instilled and suctioned) down a clean, handheld otoscope cone.
- Myringotomy should be performed if the tympanic membrane is intact but abnormal.
  - Myringotomy involves a catheter penetrating the pars tensa in the caudoventral quadrant of the tympanum catheter, accessing the middle ear.
  - When the tympanum is intact, it is important to obtain 2 samples (1 each from horizontal canal and middle ear), as bacterial isolate type and antibiotic sensitivity may differ.



3 Cytology of a sample obtained from the external ear canal showing *Pseudomonas* spp infection with numerous rod-shaped organisms (400× original magnification).

Imaging

- Imaging is useful when otitis media is present.
- Open-mouth and lateral oblique radiographic views are most informative.

CONTINUES

FOR More…

To read **Myringotomy & Ear Disease Management** by Dr. Louis N. Gotthelf, visit **cliniciansbrief.com/myringotomy-&-ear-disease-management**

- However, radiography is a poor modality for viewing mild bony changes.
- CT and MRI are superior for assessing changes within the tympanic bulla.
  - If the tympanic bulla has excessive bony change or contains large amounts of granulation tissue, prognosis for resolution by medical therapy alone is poor.

TREATMENT

Inpatient or Outpatient

- All *Pseudomonas* otitis cases benefit from thorough cleansing.
  - When cleansing the canal and middle ear, pain is best minimized with the patient under general anesthetic in a hospital environment.
- After cleansing, treatment can be on outpatient basis.

When both the canal and middle ear are involved, total ear ablation and bulla osteotomy may be necessary.

Medical

- Otitis externa is treated using topical flushes and antibiotics.
  - Benefits and use of systemic antibiotics for otitis externa (without otitis media) are controversial.
- In cases of otitis media, licensed topical medications may not be appropriate because of risks for ototoxicity; off-license topical therapy may be indicated (with client consent).

Surgical

- When examination and imaging demonstrate irreversible ear damage, surgical intervention is indicated.
  - When both canal and middle ear are involved, total ear canal ablation and bulla osteotomy may be necessary.
  - When damage is confined to the middle ear, a ventral bulla osteotomy may be more appropriate.

MEDICATIONS

Glucocorticoids

- Systemic and topical glucocorticoids reduce formation of exudate and swelling (and pain associated with inflammation).
- An antiinflammatory dose of dexamethasone is invaluable at initial flush.
  - Follow-up with topical glucocorticoids incorporated into medication (eg, dexamethasone, betamethasone, mometasone) and/or antiinflammatory doses of systemic prednisolone.

Cleaners & Flushes

- Ear cleaners and flushes (see **Flush Solutions & Antibiotic Options**) can be used to remove infected debris and inflammatory mediators.
  - They break up mucus produced by mucoperiosteum of inflamed middle ear and *Pseudomonas* spp.
- Adequate flushing provides pain relief and allows penetration of topical antibiotics.
- Acetic acid at 2% solution is lethal to *Pseudomonas* spp within a minute of contact.[3,4]
- Tris-EDTA is also a useful flush.
  - May be prepared as solution or concurrently with other topicals (eg, chlorhexidine).
  - Tris-EDTA increases permeability of *Pseudomonas* spp cell membranes by binding calcium and magnesium ions.[5]
  - Presoaking the ear canal with tris-EDTA helps potentiate aminoglycoside and fluoroquinolone antibiotics.[5,6]

Antibiotics

- Topical antibiotics, such as polymyxin, gentamicin, and fluoroquinolones (ie, enrofloxacin, marbofloxacin), are useful.
  - Ear drops with these agents are only appropriate with intact tympanum.
  - Aqueous solutions of gentamicin, marbofloxacin, and enrofloxacin are safe for ruptured ear drums.
  - Potential second-line drugs include amikacin, tobramycin, ceftazidime, silver sulfadiazine, and ticarcillin as off-licensed preparations.[7-9]

DMSO = dimethyl sulfoxide, tris-EDTA = trisaminomethane ethylenediaminetetraacetic acid

- Systemic antibiotics should be used when otitis media is present[1]; however, levels of antibiotics within the bulla will be far lower than when topically instilled.
  - Systemic medication may be the only possible therapy when the canal is swollen and hyperplastic, the owner cannot treat topically, or topical medication incited an adverse reaction.
  - Systemic therapy includes oral fluoroquinolones and injectable amikacin, based on results of culture and sensitivity testing.

Pain Management

- Opioids (eg, buprenorphine, butorphanol, tramadol) provide pain relief.
- NSAIDs are generally less effective and should not be used concurrently with glucocorticoids.

Contraindications

- If the ear drum is ruptured or cannot be evaluated, proprietary ear drops are an ototoxicity risk.

Precautions

- If the ear canal is swollen, ulcerated, and painful, cleaners and flushes containing acid, detergent, potent ceruminolytic agent, astringent, or alcohol should be avoided.

Interactions

- Antibiotics, such as aminoglycosides (eg, gentamicin, neomycin) and fluoroquinolones (eg, enrofloxacin, marbofloxacin), are inactivated by acidic solutions.
- To prevent transport of drugs into the inner ear, dimethyl sulfoxide (DMSO)-containing products should not be used in combination with aminoglycosides.

CONTINUES

If the ear canal is swollen, ulcerated, and painful, cleaners and flushes containing acid, detergent, potent ceruminolytic agent, astringent, or alcohol should be avoided.

FLUSH SOLUTIONS & ANTIBIOTIC OPTIONS

Flush Solutions

- Acetic acid (Malacetic, dechra-us.com)
- Tris-EDTA (TrizEDTA, dechra-us.com)

Topical Antibiotics—First Line

- Enrofloxacin–silver sulfadiazine (Baytril Otic, bayerdvm.com)
- Gentamicin (Easotic, virbacvet.com; Otomax and Mometamax, merck-animal-health-usa.com)
- Marbofloxacin (Aurizon, vetoquinolusa.com)
- Polymyxin (Surolan, vetoquinolusa.com)

Topical Antibiotics—Second Line

- Amikacin injectable (dilute 250 mg/mL–50 mg/mL) 4–8 drops of 50 mg/mL q12h
- Ticarcillin or ticarcillin and clavulanic acid (Timentin, us.gsk.com)
- Silver sulfadiazine (Silvadene cream [diluted with water] or powder for 1% solution)
- Ceftazidime

Topical Antibiotics—Off-License Use

- Dilute topical antibiotics in 12 mL tris-EDTA; instill 0.5 mL into ear q12h after flushing
  - Gentamicin 1 mL (40 mg/mL) (roche.com)
  - Enrofloxacin 4 mL (2% solution) (bayerdvm.com)
  - Marbofloxacin 4 mL (1% solution) (vetoquinolusa.com)

FOLLOW-UP

Patient Monitoring

- The patient should be checked 10–14 days after starting therapy.
  - The ear should be reexamined to assess improvement and patient status.
  - Cytology should be performed to gauge effectiveness of topical therapy.
- Adjust therapy if response is inadequate.
  - Rechecks may be performed q2wk until the canal has healed and cytology results are negative for bacteria and inflammatory infiltrate.

Prevention

- Owners should be taught effective ear cleansing techniques and how to recognize early signs of recurrence.
  - Suitable maintenance flushes include those containing acetic acid or tris-EDTA.
- Identification and treatment of predisposing causes are necessary.
- The patient should be reevaluated with otoscopic examination and cytology regularly (ie, every few months).

IN GENERAL

Relative Cost

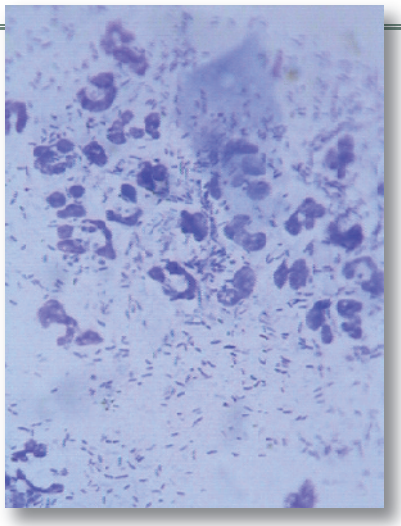
- Flush solutions: $
- Topical antibiotics (first line): $
- Topical antibiotics (second line): $–$$
- Topical antibiotics (off-label): $

Cost Key

$ = up to $100	$$$$ = $501–$1000
$$ = $101–$250	$$$$$ = more than $1000
$$$ = $251–$500	

Take-Home Points

- *Pseudomonas* otitis can occur in cats and dogs of any age.
- Predisposing factors for *Pseudomonas* otitis are those that disrupt normal ear canal environment and allow bacterial invasion.
- All *Pseudomonas* otitis cases can benefit from thorough cleansing.
- Systemic and topical glucocorticoids reduce exudate formation and swelling, cleansers and flushes remove debris and inflammatory mediators, and topical antibiotics are useful and widely available.
- Owners should be taught effective cleansing techniques and how to recognize signs of recurrence.



Cytology stain of *Pseudomonas* otitis (400× original magnification).

See **Aids & Resources**, back page, for references & suggested reading.

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