Otitis externa is a common presenting complaint in veterinary and referral practice. The prevalence of otitis externa in dogs is 10 – 20%. Often, character and smell of the discharge along with bacterial culture and sensitivity testing are common procedures used in the diagnosis of otitis externa, and as such veterinarians frequently rely on them to select antibiotic therapy for bacterial otitis externa and anti-yeast therapy for Malassezia otitis externa. Unfortunately, these findings are often unreliable and inconsistent. More suitable diagnostic techniques will be described below along with therapeutic approaches that will minimize your need for third- and fourth-generation antibiotics.

**Presenting complaint: otitis externa**

The signs of otitis can help differentiate between bacterial and yeast; however, diagnostics to confirm the clinical suspicions should always be performed. The classic presentations can be divided into purulent and non-purulent otitis as follows:

**BACTERIAL and CANDIDA OTITIS EXTERNA**
- head shaking or ear scratching
- purulent exudate (occasionally hemopurulent or mucoid)
- malodour, swelling, inflammation, ulceration, and pain

**MALASSEZIA OTITIS EXTERNA**
- head shaking or ear scratching
- waxy discharge, typically brown
- malodour, swelling, inflammation, and pain

### Lesion pattern on physical exam and probable underlying etiology

The age, severity of the otitis and distribution of cutaneous lesions other than the otitis can provide insight into the diagnosis as follows:

<table>
<thead>
<tr>
<th>LESION PATTERN</th>
<th>UNDERLYING ETIOLOGY</th>
<th>FREQUENCY</th>
<th>AGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ears (moderate–severe), feet, rear</td>
<td>FOOD</td>
<td>Common</td>
<td>&lt;6m, &gt;6yr</td>
</tr>
<tr>
<td>Ears (mild–moderate), axilla, ventrum</td>
<td>ENVIRONMENT</td>
<td>Common</td>
<td>6m-6yr</td>
</tr>
<tr>
<td>Ears (ceruminous/waxy), alopecia, seborrhea</td>
<td>HYPOTHYROIDISM</td>
<td>Common</td>
<td>&gt;5yrs</td>
</tr>
<tr>
<td>Ear (unilateral, less likely bilateral)</td>
<td>FOREIGN BODY</td>
<td>Uncommon</td>
<td>any age</td>
</tr>
<tr>
<td>Ear(s) (unilateral/bilateral)</td>
<td>OTODECTES CYNOTIS</td>
<td>Uncommon</td>
<td>any age</td>
</tr>
<tr>
<td>Ear(s), pinna(e), extensor elbows/hocks</td>
<td>SARCOPTES SCABIEI</td>
<td>Uncommon</td>
<td>any age</td>
</tr>
<tr>
<td>Ears, pinnae, trunk, follicular casts</td>
<td>PRIMARY KERATINIZATION</td>
<td>Rare</td>
<td>&gt;2yrs</td>
</tr>
<tr>
<td>Ear (unilateral, less likely bilateral)</td>
<td>NEOPLASIA</td>
<td>Rare</td>
<td>mature</td>
</tr>
</tbody>
</table>

**Diagnostic considerations for otitis externa**

In this day of communicable/zoonotic, methicillin-resistant, and other bacteria, it is advisable to AVOID sniffing infected ears, as it does not provide accurate information. The visual character of the discharge may also be misleading. For example, candidiasis can result in a mucopurulent discharge with ulcerative aural lesions similar to that of *Pseudomonas*. Therefore a logical approach to characterizing the otitis is necessary and varies between an acute case and relapsing otitis externa as follows:

<table>
<thead>
<tr>
<th></th>
<th>NEW CASE (INITIAL VISIT AND 10–14 DAY RECHECK)</th>
<th>RELAPSING CASE (&gt;2 TIMES PER YEAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical and clinical assessment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>(Video) Otoscopy</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cytology</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Food elimination trial</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>General anesthetic + ear flush + video otoscopy +/- myringotomy (ear drums regrow within 21–28 days in a healthy environment)</td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td>Otic culture and sensitivity if suspect otitis interna</td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td>Brainstem auditory evoked response test (BAER)</td>
<td>+/-</td>
<td></td>
</tr>
</tbody>
</table>
Cytology

- SAMPLE from AFFECTED areas of the ears – not always horizontal–vertical ear canal junction
- Heat fix and DiffQuik® slides
- Yeast or cocci with no clinical sign = commensal → do NOT treat
- Yeast alone with clinical signs → treat
- Cocci with phagocytes → treat
- Rods +/- phagocytes → treat
- Phagocytes in the absence of yeast or cocci = drug reaction → STOP treatment + flush with saline daily

Otitis externa broad therapeutic principles

1. Address underlying etiology
   i. Food allergies: Dietary trial
   ii. Environmental allergies: topical, systemic symptomatic, or immunotherapy
   iii. Hypothyroidism: thyroid supplementation
   iv. Foreign object: extract
   v. Otodectes and Sarcoptes: systemic macrocyclic lactone (ivermectin/avermectin) – treat all in-contact pets
   vi. Conformational deformities: surgical correction
   vii. Primary keratinization disorder: oral vitamin A (1000 IU/kg/d), treat specific condition
   viii. Masses (polyps, cysts, adenoma/adenocarcinoma): surgery +/- radiation therapy

2. Calm the microenvironment
   i. Topical corticosteroid
   ii. +/- Per os systemic corticosteroid and/or cyclosporine
   iii. +/- Intraliesional triamcinolone for hyperplastic ears

3. Address the infectious agent
   a. Yeast
      – Clean with ceruminolytics, acidic
      – Most effective topical antifungal
      – +/- Systemic antifungal
   b. Cocci
      – Clean with ceruminolytics, acidic
      – Most effective topical antimicrobial
   c. Rods
      – Clean with Tris-EDTA (surfactant, calcium binding)
      – Most effective topical antimicrobial
   d. Otitis media/interna
      – Systemic antibiotics based on culture and sensitivity from middle ear
      – May need to do myringotomy and saline flush to get appropriate sample
      – Eardrums regrow within 21–28 days in a healthy environment
Treatment End-Points

1. **(Video-) Otoscopy:** normal clinical appearance (i.e., no inflammation) : normalization of the self-cleaning ear (i.e., lack of debris)

2. **Follow-up cytology:**
   a. **Pseudomonas:**
      - No evidence of (Gram-negative) rod-shaped bacteria
      - No evidence of inflammatory cells (e.g., neutrophils)
   b. **Staphylococcus:**
      - Normal population of commensal cocci
      - No evidence of inflammatory cells (e.g., neutrophils)
   c. **Malassezia:**
      - Normal population of commensal yeast
      - No evidence of inflammatory cells (e.g., neutrophils)

3. **Follow-up culture:**
   a. **Pseudomonas:**
      - Acute cases – not necessary
      - Chronic cases – recommended – culture negative
   b. **Staphylococcus:**
      - Antibiotic responsive cases – not necessary
      - Methicillin-resistant Staphylococcus – recommended – culture negative
   c. **Malassezia:**
      - Not necessary

4. If follow-up end points are not achieved during the labelled course of treatment, repeat cycle of therapy according to manufacturer’s recommendations.

Otic preparation selection criteria

1. **Facilitate and ensure owner compliance:**
   a. Lowest frequency of administration
   b. Shortest duration of treatment
   c. Application device

2. **Anti-inflammatory**
   a. High binding affinity to GC receptors, once-a-day application to improve compliance
   b. High potency for rapid relief of pain and pruritus
   c. Minimal systemic absorption to minimize secondary effects
   d. Minimal local secondary effects

3. **Antibiotic and antifungal**
   a. Concentration-dependent products once daily to improve compliance and efficacy
   b. Most effective spectrum of activity to minimize resistance (MPC)
   c. Efficacy against biofilm producers (e.g., Pseudomonas, E. coli, Malassezia)
   d. Minimal systemic absorption to minimize secondary effects
   e. Minimal local secondary effects
      i. Know patient’s specific sensitivities
      ii. Number 1 cause of skin contact sensitization = neomycin
      iii. Direct contact ototoxicity of polymyxin

Note: Improper use of antibiotics selects for resistance
1. Failure to reach effective concentrations at tissue level
2. Premature discontinuation of antibiotics
3. Lack of owner compliance/adherence is important
Steroids

Systemic effect following topical corticosteroid in healthy dogs and dogs with otitis externa.

<table>
<thead>
<tr>
<th>ADRENOCORTICAL SUPPRESSION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triamcinolone acetonide Fluocinozide Betamethasone valerate</td>
<td><strong>After 2 days</strong> on healthy ears</td>
</tr>
<tr>
<td>Dexamethasone Triamcinolone</td>
<td><strong>After 7 days</strong> on healthy ears</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td><strong>After 14 days</strong> twice daily in normal dogs 0.01% in saline – no suppression 6/6 0.1% in saline – suppression in 4/7 (57%) 0.1% in propylene glycol – suppression in 4/6 (66%)</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td><strong>After 2 weeks</strong> of otic treatment on healthy ears: Five of seven dogs (71.43%) in the dexamethasone group had suppressed adrenocortical responses to exogenous ACTH</td>
</tr>
<tr>
<td>Betamethasone Triamcinolone Dexamethasone</td>
<td><strong>After 7 days</strong> on ears with otitis externa</td>
</tr>
<tr>
<td>Mometasone</td>
<td><strong>NORMAL after 7 days</strong> on ears with otitis externa</td>
</tr>
</tbody>
</table>

Topical corticosteroid safety ranking
1. Hydrocortisone, Mometasone
2. Prednisolone
3. Betamethasone,
4. Fluocoinide, Triamcinolone
5. Dexamethasone

Topical corticosteroid activity ranking
1. Fluocinonide*, Mometasone
2. Betamethasone, Dexamethasone
3. Triamcinolone
4. Prednisolone
5. Hydrocortisone

(*Usually combined with DMSO for increased absorption)

Antibiotic pharmacodynamics categories

To be effective:

a. Concentration-dependent antibiotics are most effective when the dose is given once a day
b. Time-dependent antibiotics require consistency of concentrations above MIC throughout the day

<table>
<thead>
<tr>
<th>CONCENTRATION-DEPENDENT</th>
<th>TIME-DEPENDENT</th>
<th>TIME-DEPENDENT, CONCENTRATION-ENHANCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aminoglycosides</td>
<td>Beta-lactams</td>
<td>– Macrolides</td>
</tr>
<tr>
<td>– Gentamicin</td>
<td></td>
<td>– Streptogramins, Tetracyclines</td>
</tr>
<tr>
<td>– Amikacin</td>
<td></td>
<td>– Polypeptides (Polymyxin, Bacitracin)</td>
</tr>
<tr>
<td>– Neomycin</td>
<td></td>
<td>– Oligopeptide (Thiostrepton)</td>
</tr>
<tr>
<td>– Framycetin</td>
<td></td>
<td>– Fusidic acid</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td></td>
<td>– Silver sulfadiazine</td>
</tr>
<tr>
<td>– Enrofloxacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Marbofloxacin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Biofilms can’t be beat

Gentamicin is an aminoglycoside with a good antibacterial profile against many of the gram-positive and gram-negative agents commonly found in otitis externa. Aminoglycosides are concentration-dependent antibiotics with bactericidal activity. Pseudomonas aeruginosa, when present, can lead to ulceration and inflammation within the ear canal. Recent work presented at the 2013 North American Veterinary Dermatology Forum described 83 multi-drug resistant P. aeruginosa isolates from dogs with otitis externa from Canada. Forty percent of these isolates were biofilm producers. Biofilm bacteria susceptibility testing revealed that MICs were significantly higher in biofilm-embedded versus planktonic bacteria for all antimicrobials tested. Gentamicin had a favorable in-vitro profile compared to both polymyxin B and neomycin against either the planktonic or the biofilm-embedded P. aeruginosa.


When to recommend systemic antimicrobials and antifungals

1. Delivery issues: proliferative ear disease, painful ear
2. Poorly compliant owner
3. Otitis media/interna
4. Lack of efficacy with topicals
5. Generalized distribution; other regions of the body affected
6. Bacterial Malassezia hypersensitivity cases

Ototoxicity:

Direct neurotoxicity/ototoxicity (topically on ruptured tympanic membrane)
- Polymyxin, colistin (cochlear)
- Burow’s solution (sensorineural)

Systemic neurotoxicity/ototoxicity = high systemic dose, prolonged treatment
- Thiabendazole (vestibular)
- Aminoglycosides (gentamicin, amikacin, neomycin, framycetin – vestibular)

MythBusters

1. Swimmer’s Ear exists in our pets
   Moisture in the ear is only an issue if inflammation is present (likely due to allergies). The hot ear canal with water added will act as an incubation chamber for the bacteria. Note that for every Labrador retriever that develops an ear infection after swimming, there are another 499 Labradors that simply shake their head and go about their business.

2. Ototoxicity is associated with aminoglycoside use
   As long as the oval and round window dividing the middle from the inner ear are intact, then ototoxicity is not an issue with aminoglycosides, even in an ear with a ruptured tympanic membrane when topical medications are used.

Strain GM, Merchant SR, Neer TM, Tedford BL. Ototoxicity assessment of gentamicin sulfate otic preparation in dogs. JAVMA 1995; 56(4); 532-538
3. Cockers and Labs need cleansing regularly
Cerumen (wax) is produced in excess as a protective mechanism during an inflammatory event and also in hypothyroid individuals. However, for every cocker spaniel and Labrador retriever with ceruminous otitis externa, there are another 4,999 that are normal without any evidence of ear disease. Dealing with the underlying etiology and inflammation will normalize the cerumen production and eliminate the need to regularly cleanse the ears.

4. Otitis externa is a primary diagnosis
Otitis is rarely a primary diagnosis on its own. There are multitudes of underlying etiologies that cause otitis externa along with predisposing and perpetuating factors. Therefore treatment of repeated bouts otitis externa should always encompass a search and treatment of the underlying etiology to prevent further flare-ups.

5. Burow’s is a safe product to use in patients with ruptured tympanic membranes
Two human cases of acute sensorineural hearing loss occurred soon after the administration of Burow’s solution as eardrops. These cases demonstrated that Burow’s solution can be potentially ototoxic. Although toxicity of Burow’s solution has not been studied in veterinary medicine, it should be used with caution in patients presenting with otitis media accompanied by a tympanic membrane perforation.


6. Save the “Big Gun”
There is no such thing as a “Big Gun” in veterinary otology primarily because antibiotics placed directly in the ear canal typically achieve concentrations that far exceed (10–1,000 times) those of the MIC for the organisms involved. Culture and sensitivity for topical antimicrobials and their concentration is currently not readily available in a commercial setting. The Kirby-Bauer sensitivity and MICs represent the SYSTEMIC delivery of antibiotics rather than the TOPICAL delivery. Therefore selection of an antibiotic should be based on the anticipated efficacy of that product for the organism in question.


7. Miconazole is superior to Clotrimazole
In multiple studies, clotrimazole and miconazole have very similar efficacy profiles. Laboratory methods for testing sensitivities of yeast are only now coming to light, but they have yet to be standardized. It is interesting to see that the Vetoquinol company uses miconazole in its first-line otic product while it uses clotrimazole in its second-line product. Clotrimazole-based products have also been used as the test standard during inferiority testing of other otic products, therefore denoting that the clotrimazole-based product is the one to live up to. Regional variation may certainly contribute to perceived resistance or lack of efficacy, but in general, both are efficacious.


8. What is acute versus chronic ear infection/medication
ACUTE otitis would represent a one-time, short duration (~7- to 14-day) ear infection. CHRONIC otitis is characterized by ear infections lasting more than 14 days and/or recurrent in nature. In ACUTE cases, manufacturers’ recommendations should be followed. With CHRONIC cases, repeated courses of ACUTE therapy may be required along with addressing the underlying etiology and potential systemic anti-inflammatory therapy, such as glucocorticoids or cyclosporine. Dosing and duration of the systemic anti-inflammatory medication is based on the severity of the ear infection.

9. Diagnosis by smell and discharge
Diagnosing the infectious agent by smell and discharge is often misleading. Brown discharge can be attributable to Malassezia, cocci and Otodectes. Purulent discharge with ulceration is often associated with Pseudomonas but may also be caused by Candida albicans and adverse drug reactions. Likewise, the predictability of odour to provide insight regarding the infectious organism is not only poor, but also potentially dangerous, especially considering the incidence of methicillin-resistant staphylococcal organisms.

10. Drop versus cc equivalent
Each drop from a bottle of ear medication is typically standardized to deliver 0.025ml. Therefore, the total daily volumes of products delivered as drops typically range per label from 0.1 ml (4 drops per day) to 0.5 ml (10 drops twice daily). The volume of the external ear canal has been determined by various methods to range from 0.5 to 2.5 cm3. Using fluorescent dye studies to label ear treatment products, it has been reported that it takes 0.5 to 1 ml of medication to get down to the tympanic membrane in dogs.

WITH THESE FACTS IN MIND, WE RECOMMEND ADMINISTERING THE FOLLOWING TO ACHIEVE SUFFICIENT CONTACT AND CONCENTRATION OF EAR MEDICATIONS WHILE TREATING AN INFECTION:

| Small dog or cat | e.g., Yorkshire terrier | 0.25 ml | 10 drops |
| Medium breed dog | e.g., Cocker spaniel   | 0.5 ml  | 20 drops |
| Large breed dog  | e.g., Golden retriever | 0.75 ml | 30 drops |
| Giant breed dog  | e.g., Newfoundland   | 1.0 ml  | 40 drops |

11. Contamination of leftover products

Be certain to dispense the correct quantity to equal the labelled treatment course since this will avoid contamination of ear products as well as owners having insufficient volumes/ concentrations of medication when trying to make the bottle last for another treatment course. As recontamination of an ear when cleansing can be a cause for recurrence, utilization of individual pipettes or small containers is ideal so that the containers can be discarded after one use or one treatment course.


12. Selection of topically applied ear medications should be based on culture/sensitivity findings

Otic cytology is quantitative, giving the clinician a rapid indication of the relative number of morphologically different species present in the ear, which may aid in empirical selection of otic therapy. Discordance between cytology and otic cultures has been reported by Graham-Mize et al., and for this reason, it must be emphasized that otic cultures should always be interpreted with reference to concurrent cytology done by the clinician at the time of sampling, and the results of both these diagnostic tests should be interpreted in light of the otic examination. As well, otic cultures are fraught with many challenges and controversies, hence I tend to only pursue otic bacterial culture and sensitivity when:

1. The infection has failed to respond to appropriate medication despite good owner compliance indicative of resistant bacteria (MRSA, MRSS, MRSI).
2. When otitis media is present (head tilt), especially if systemic antibiotics are to be used.


13. Breaking the “habit” of reaching for one ear product

Rather, one should choose ear products based on ingredients, not the name. When choosing an ear medication, be certain that it contains the necessary ingredients to address what you have identified on cytology. Choose ingredients with the greatest efficacy and highest safety margins that are applicable for the dosing regimen outlined. Choose a once-daily treatment to increase owner compliance.

14. Compounded ear products better than formulated

The sale and application of compounded products has many potential implications that should be considered. These include safety factors, quality, potency, and efficacy. The legislative veterinary bodies have a hierarchy of medication selection that veterinarians should legally abide by, as follows (CVMA July 2010, Decision Cascade for Legitimate Use of Drugs in Veterinary Practice):

- a. Veterinary licensed – on-label use
- b. Veterinary licensed – extra-label use
- c. Human licensed drug – extra-label use
- d. Compounded drug – from approved veterinary drug
- e. Compounded drug – from approved human drug
- f. Compounded drug – from active pharmaceutical ingredient

15. Hearing loss is easily detected by owners

In a recently presented study based on a comparison of BAER and owners’ ability to detect hearing loss in their pet, owners were able to detect whether their pet was perfectly normal or moderately to profoundly BILATERALLY deaf (BILATERAL Grade II; Grade III; Grade IV) with 100% certainty. Owners were not, however, able to detect slight (Grade I), moderate (Grade II), and severe (Grade III) UNILATERAL hearing loss at all. Therefore, hearing loss in dogs may have either pre-existed the start of topical medication or the topical medication may act as a physical barrier for sound waves since most treatments are either a fluid or viscous ointment. Discontinuing use of the topical medication in question along with flushing the ear(s) once daily for 7–14 days using saline should help restore hearing to its original level prior to treatment.

Ball CL, Paterson S. Study to compare owner perception of their dog’s hearing and brainstem auditory-evoked response findings in 45 dogs. Vet Derm 2012

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