Otitis Externa: Management or Cure?

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Otitis externa is defined as inflammation of the external ear canal including the ear pinna. Cases of otitis externa may be acute or chronic in nature. In cases of chronic otitis, cycles of inflammation and infection lead to pathological changes within the ear canal that can then make flares more severe and frequent.[1] Clinical signs of otitis externa in companion animals include head shaking, scratching at the ear, odor, abnormal carriage of the pinnae, erythema, debris within the ear canal, crusting, hyperpigmentation, alopecia, excoriations, erosions, ulceration and stenosis.[2] Neurologic abnormalities such as head tilt, nystagmus, ataxia and cranial nerve deficits may occur with otitis media and interna.[2] Otitis externa can be divided into subcategories of erythemato-ceruminous otitis (erythema with ceruminous discharge) and suppurative otitis (erythema, ulceration, purulent discharge +/- biofilm formation).[1]

PPPS system

Multiple factors contribute to the development of otitis externa and these factors are often referred to as the PPPS system – Primary, Predisposing, Perpetuating and Secondary factors (see table below).[2] Primary factors are those which directly induce inflammation within the ear canal. The most common primary factor leading to otitis externa is underlying hypersensitivity disease.[3] Predisposing factors alter the environment of the ear canal to create increased risk for the development of otitis, such as excessive moisture in the ear.[2,4] Perpetuating factors are pathologic changes that prevent full resolution of the otitis externa such as glandular hyperplasia, stenosis etc.[4] Certain breeds have anatomical changes in their ear canals making them more prone to the development of otitis if a primary factor is present. For example, Cocker spaniels have a greater density of ceruminous glands than other breeds. This predisposes them to glandular hyperplasia and cyst formation.[5] From studies glandular hyperplasia may precede development of other clinical signs of otitis externa in this breed. These pathologic changes facilitate bacterial infections and can be less responsive to glucocorticoids therefore expediting end-stage otitis and the need for surgical intervention.[5]

Secondary factors are infectious organisms such as bacteria and yeast that can lead to infections within the canal. S*taphylococcus* species are the most common bacteria isolated from cases of canine otitis externa.[6] *Pseudomonas, Enterococcus, Streptococcus and Corynebacteriaum* are also routinely cultured from the ears of dogs with otitis. *Malassezia* is the most common yeast isolated from cases of canine otitis externa.[2] Most dogs presenting to the clinic with clinical signs of otitis externa have secondary infections. However, it is important to remember that not all inflamed and pruritic ears are infected. Otitis can be inflammatory in nature or clinical signs worsening could be due to a contact reaction to topically applied otic preparations. Otic cytology will help differentiate infectious otitis from inflammatory.

Most importantly, all recurrent ear infections are secondary to an underlying factor.[3] When treating chronic or recurrent otitis it is paramount to remember to address the primary factor in otitis development. Without doing so otitis will continue to occur.

Factors in Otitis Development[7]

Primary	**Predisposing**	**Perpetuating**	**Secondary**
Hypersensitivity	Excessive hair	Otitis media	*Malassezia*
Otodectes cyanotis	Moisture	Stenotic ear canals	Bacteria
Endocrine disease	Increased cerumen	Ceruminolith	
Neoplasia	Frequent cleaning	Otitis interna	

Foreign bodies	Humidity		
Auto-immune disease	Conformation		
Keratinization disorders	Plucking ears		

Diagnostic Work-up

To identify the primary factor in otitis development one should pay close attention to the signalment of the patient as well as obtain a thorough history from your clients. Other dermatologic disease, systemic signs or historical information might help narrow down your differential list. Seasonality of otic issues may indicate a seasonal allergy (atopy) or seasonal parasitic infestation.

With every case of otitis externa cytology should be performed to document any secondary infection present. Cytology of both ears should always be obtained and viewed even if, historically, one ear has been problematic. Cytology of an unaffected ear gives you a baseline and idea of what is "normal flora" in a patient. I have also lost track of the amount of times a client has reported to me that only one ear gets infected to then find both infected on cytology! Cytology is the only way to verify that there is a secondary infection and hence guide topical antimicrobial treatment. Please do not "sniff" or smell ears-this is not an accurate diagnostic test! Some cases of otitis have a thick, dark and slimy discharge which can be indicative of biofilm production. On cytology you may see pink, lacey or "veiled" material with bacteria and neutrophils embedded.[7] The microbiota of canine ears has been studied and can vary between individuals. In unaffected canines the most abundant phyla are Proteobacteria, Actinobacteria, Firmicutes, Fusobacteria, and Bacteroidetes.[8] Inflamed ears show lower diversity with about 70% showing a bacterial, 16% a fungal, and 7% a mixed overgrowth.[8] The most important organisms are *Malassezia pachydermatis*, *Staphylococcus pseudintermedius*, and *Staphylococcus schleiferi* with some infections also being caused by *Pseudomonas* spp. The fungal microbiota is dominated by *Malassezia* spp, specifically *Malassezia pachydermatis* on atopic skin/ears.[9]

An otoscopic examination should be attempted in every case of otitis externa. In many cases this may require sedation or general anesthesia pending the patient's tolerance for the procedure. Otoscopic examination will help the clinician identify if the tympanum is intact, the type of lesions and discharge within the external ear canal, presence of foreign bodies or masses and whether the canal is stenotic. Both ears should be examined starting with the unaffected ear if the otitis externa is unilateral; this allows for comparison between the 2 ears and is easier on the patient. Separate cones should be used for each ear or the cone should be disinfected between use in the ears to prevent transmission of infection. If the tympanic membrane is ruptured, this raises suspicion of a concurrent otitis media. If the tympanic membrane is intact, this does not rule out presence of otitis media as the tympanic membrane could have previously ruptured but then healed. If otitis media is documented, then a bacterial culture and susceptibility should be performed to allow guidance for systemic therapy. Ideally the culture obtained would come directly from the middle ear after a myringotomy has been performed. In situations where this cannot be done, a culture can be taken from the external ear itself. Cytology should still be performed to document that there is an infection and that bacteria are the infectious agent present prior to culture.

Sedation or anesthesia might be required in a painful patient to allow for a thorough otoscopic examination. Alternatively, if the patient is in pain, or the canal is stenotic, 7 to 14 days of anti-inflammatory therapy with an oral glucocorticoid such as prednisone or dexamethasone can precede the otoscopic examination. This will decrease inflammation and open up the ear canal to allow better visualization. If otitis externa is unilateral this should prompt a thorough otoscopic examination under sedation or anesthesia. Rule outs for unilateral otitis would include foreign body, mass, polyp or ceruminolith which can be seen during a sedated/anesthetized otoscopic examination.

Especially with chronic otitis, ear canals should be palpated. With chronicity we can see changes within the ear canal such as glandular hyperplasia, stenosis and even ear canal mineralization. Irreversible changes to the ear may require surgical intervention such as a total ear canal ablation and bulla osteotomy (TECA-BO).[1]

Studies have shown that upwards of 41% of chronic otitis cases have concurrent otitis media.[10]
If there is a concern for otitis media but the tympanic membrane is intact, diagnostic imaging such as CT or MRI can be helpful to document otitis media.

Treatment

Treatment of otitis externa has two components - Induction of treatment and maintenance therapy. During induction we aim to reverse pathological changes in the ear, eliminate infection and restore the normal canal structure and function.[1] Maintenance therapy serves to maintain improvement and prevent recurrence.

Induction

Otitis externa should be treated with topical otic drops based on cytology. A bacterial culture and susceptibility does not need to be performed prior to topical treatment. Previous studies have shown that clinical response to topically applied antibiotics does not correlate with antimicrobial susceptibility results.[11] Topical azoles are most commonly used for yeast. Topical fluoroquinolones, gentamicin, fusidic acid are effective against cocci. Topical fluoroquinolones, gentamicin, and polymixin B are usually effective against *Pseudomonas*.[12-14] Ototoxicity has been previously reported with gentamicin instilled topically into the ear canal with a ruptured tympanic membrane. However, one study showed no ototoxic effects when gentamicin was instilled twice daily into ears with ruptured tympanic membranes for a 3-week period.[15] When using topical medication, it is most important to make sure an adequate volume of the medication is being used. A volume can be recommended based on the dog's size. For example, in small breed dogs 0.25 mL can be instilled, medium-sized dogs: 0.5 mL, large breed: 0.75 mL, and giant breeds a full 1 mL/ear. In cats, 0.25ml can be instilled into each ear. Topical medications are used once or twice daily depending on the medication selected.

If the canal is not ulcerated or eroded, systemic antibiotics are unlikely to reach therapeutic concentrations in the ear canal.[14] However, if ulceration is present along the external ear canals, as if often the case with *Pseudomonas,* systemic antimicrobials will penetrate the ear canal more readily. If systemic antibiotics are to be prescribed, this should be done following an aerobic bacterial culture and susceptibility. This culture will definitively identify the species of bacteria and will allow identification of the susceptibility patterns of that organism which can guide antibiotic selection.[12-14] If there is known otitis media, or a concern for otitis media, systemic antimicrobials based on culture and susceptibility testing should be started and prescribed for a minimum of 4 weeks.

If pets will not tolerate application of topical medications at home, there are commercial leave-in preparations available that can be instilled in clinic. These leave in products contain florfenicol/terbinafine/ mometasone furoate or florfenicol/terbinafine/ betamethasone and can maintain therapeutic concentrations in the ear canals for up to 35 days. These topicals can have a significant impact on owner and pet quality of life.[16] However, side effects with these medications have been noted and they cannot be used for every case of otitis externa.[17] Florfenicol is not effective against *Pseudomonas* spp. So these products cannot be used when rods are noted on cytology. Another option if pets won't tolerate application at home due to sensitivity is to first prescribe a 7-14 day course of systemic glucocorticoids to open up the ear canal and relieve some pain prior to instillation. Compounded ear packs are also available for cases where rod shaped bacteria are noted and clients cannot treat their pet at home.

Cleaning or flushing of the ear will help to remove any debris, purulent material and micro-organisms. During an episode of otitis, epidermal migration breaks down which allows desquamated cells, cerumen, and debris to build up.[18] The type and amount of exudate present will determine which cleaner is most beneficial. If owners are unable

to clean the patient's ear at home, then a thorough flushing of the ear in hospital using sterile saline or an ear cleaner is warranted. This flushing should be performed under general anesthesia. Some topical antimicrobials, such as the aminoglycosides, are inactivated in purulent material; therefore, cleaning/flushing is imperative before their use to allow for better activity of the antimicrobial. Some alcohol and acidic based cleaners may irritate inflamed ears. In previous studies, acetic acid has been found to be most effective against *Pseudomonas,* especially when used as a 2% solution.[19] TrizEDTA will damage bacterial cell walls by chelating minerals in the wall allowing better penetration of topical antimicrobials. The use of TrizEDTA will help increase antimicrobial efficacy which is especially important in cases of *Pseudomonas* otitis externa. Cleaning with TrizEDTA should be done approximately 15 to 30 minutes before instilling topical antimicrobials and does not appear to be ototoxic.[2] TrizEDTA has been shown, *in vitro,* to reduce the minimum inhibitory concentration (MIC) of marbofloxacin and gentamicin for multidrug resistant *P. aeruginosa*.[20] It has also been shown *in vitro* to reduce the MIC for biofilm imbedded *P. aeruginosa* for certain antimicrobials.[21] Cleaning ears to reduce debris and remove microorganisms prior to and during therapy can be useful. I prefer not to over clean and taper my use of cleaning agents quickly after debris has resolved. My concern is that excessive liquid in the ear acts as perpetuating factor (moisture).

Most cases of, especially chronic, otitis externa, will benefit from an oral anti-inflammatory such as a glucocorticoid for a short duration to decrease inflammation and provide some pain relief. Steroids can decrease inflammation and reduce stenosis thereby opening up the external ear canal to allow better application of topical therapy as well as reversing some pathologic changes in the canal.

Once topical therapy for the otitis externa has been completed, cytology MUST be repeated to verify resolution of the infection. Simply assessing the ear visually is not enough to define resolution, cytology must be completed also. This is of paramount importance moving forward to determine that your therapy for the primary cause of otitis development is effective. If otitis recurs after infection is treated, this means that the primary factor in otitis development has yet to be identified or managed.

Maintenance

The biggest factor in maintenance therapy for otitis is to identify and treat the primary factor. This may involve testing for endocrine disease, an elimination diet trial or therapy for atopic dermatitis. If medical management for atopic dermatitis and otic inflammation is warranted, glucocorticoids can be continued but, obviously, have many risks associated with chronic use. Another alternative for longer term maintenance is cyclosporine. Other options for maintenance, if the patient is still experiencing the occasional flare of ear disease, are topical steroids such as Burrow's or Cortotic (Virbac, launching June 2024). Studies have shown previously that hydrocortisone aceponate when applied into the ear was beneficial at preventing otitis in dogs with allergic otitis.[22] A newer study found that this new otic hydrocortisone aceponate spray was found to decrease the otitis score in canine cases of otitis externa.[23] The use of topical glucocorticoids does not appear to change the microbiota in canine ears.[24]

Biofilms

One virulence factor contributing to the ability of certain bacteria to cause chronic otitis is their ability to form biofilms. Biofilms, once established, enable bacteria to colonize tissues and shelter them from cleaning, antimicrobials and the immune response. Bacteria within biofilms can also "share" characteristics between each other including resistance to antimicrobials. Almost all microbes can form biofilms; they are most common with *Pseudomonas* spp in otitis but can be seen with *Staphylococcus* spp, other bacteria, and *Malassezia* yeasts.[25,26] *Pseudomonas aeruginosa* isolates from cases of canine otitis externa have been documented to form biofilms in about 40% of cases, and biofilm formation increases the minimum inhibitory concentration of antimicrobials needed to treat the infection.[25] As previously mentioned, Triz-EDTA has also been shown *in vitro* to reduce the MIC

for biofilm imbedded *P. aeruginosa* for certain antimicrobials.[21] N-acetyl cysteine (NAC) can damage biofilms, lower the MIC, and enhance the efficacy of systemic antibiotics. It is therefore possible that NAC and similar antibiofilm compounds may aid the treatment of biofilm-associated infections in animals.[26]

References

1. Nuttall T. Managing recurrent otitis externa in dogs: what have we learned and what can we do better? JAVMA. 2023;261:S10-S22.
2. Miller WH, Griffin CE, Campbell KL. Diseases of eyelids, claws, anal sacs and ears. In: Miller WH, Griffin CE, Campbell KL, eds. Muller & Kirk's Small Animal Dermatology. 7th ed. Elsevier; 2013:714–773.
3. Saridomichelakis MN, Farmaki R, Leontides LS, Koutinas AF. Aetiology of canine otitis externa: A retrospective study of 100 cases. Vet Dermatol. 2007;18:341–347.
4. August JR. Otitis externa. A disease of multifactorial etiology. Vet Clin North Am Small Anim Pract. 1988;18(4):731–742.
5. Kaimio M, Malkamäki S, Kaukonen M, et al. Clinical and genetic findings in 28 American cocker spaniels with aural ceruminous gland hyperplasia and ectasia. J Comp Pathol. 2021;185:30–44.
6. Malayeri HZ, Jamshidi S, Salehi TZ. Identification and antimicrobial susceptibility patterns of bacteria causing otitis externa in dogs. Vet Res Commun. 2010;34:435–444.
7. Nuttal T. Managing chronic and recurrent otitis externa in dogs. Dermatology Small Animal Online Edition. 2018 Volume 6;Issue 6:23-29.
8. Tang S, Prem A, Tjokrosurjo J, et al. The canine skin and ear microbiome: a comprehensive survey of pathogens implicated in canine skin and ear infections using a novel next-generation-sequencing-based assay. Vet Microbiol. 2020;247.
9. Korbelik J, Singh A, Rousseau J, Weese JS. Analysis of the otic mycobiota in dogs with otitis externa compared to healthy individuals. Vet Dermatol. 2018;29(5):417-e138.
10. Belmudes A, Pressanti C, Barthez PY, Castilla-Castaño E, Fabries L, Cadiergues MC. Computed tomographic findings in 205 dogs with clinical signs compatible with middle ear disease: a retrospective study. Vet Dermatol. 2018 Feb;29(1):45-e20
11. Robson D, Burton G, Bassett R. Correlation between topical antibiotic selection, in vitro bacterial antibiotic sensitivity and clinical response in 16 cases of canine otitis externa complicated by *Pseudomonas aeruginosa*. Proc North American Veterinary Dermatology Forum; Portland, Oregon. April 14–17, 2010.
12. Morris DO. Medical therapy of otitis externa and otitis media. Vet Clin North Am Small Anim Pract. 2004;34:541–555.
13. Paterson S, Matyskiewicz W. A study to evaluate the primary causes associated with pseudomonas otitis in 60 dogs. J Small Anim Pract. 2018;59:238–242.
14. Pye C. *Pseudomonas* otitis externa in dogs. Can Vet J. 2018 Nov;59(11):1231-1234.
15. Strain GM, Merchant SR, Neer TM, Tedford BL. Ototoxicity assessment of a gentamicin sulfate otic preparation in dogs. Am J Vet Res. 1995;56:532–538.
16. Noli C, Sartori R, Cena T. Impact of a terbinafine-florfenicol-betamethasone acetate otic gel on the quality of life of dogs with acute otitis externa and their owners. Vet Dermatol. 2017;28(4):386-e390.
17. Bercovitz GR, Gaerig AM, Conway ED, et al. Long-lasting otic medications may be a rare cause of neurogenic keratoconjunctivitis sicca in dogs. J Am Vet Med Assoc. 2022;261(1):97–103.
18. Nuttall TJ, Cole LK. Ear cleaning: the UK and US perspective. Vet Dermatol. 2004;15(2):127–136.
19. Thorp MA, Kruger J, Oliver S, Nilssen EL, Prescott CA. The antibacterial activity of acetic acid and Burow's solution as topical otological preparations. J Laryngol Otol. 1998;112:925–928.
20. Buckley LM, McEwan NA, Nuttall T. Tris–EDTA significantly enhances antibiotic efficacy against multidrug-resistant *Pseudomonas aeruginosa* in vitro. Vet Dermatol. 2013;24:519–e122.

21. Pye C, Singh A, Weese JS. Evaluation of the impact of tromethamine edetate disodium dihydrate on antimicrobial susceptibility of *Pseudomonas aeruginosa* in biofilm in vitro. Vet Dermatol. 2014;25:120–123.
22. Bergvall KE, Ahman S, Mueller R *et al.* Can topical hydrocortisone aceponate effectively control allergic otitis externa and reduce the risk of recurrence? A double-blinded, placebo-controlled, prospective study (abstract). Vet Dermatol. 2017;28:535.
23. Rigault D, Briantais P, Jasmin P, Bidaud A. Efficacy and safety of a hydrocortisone aceponate-containing ear spray solution in dogs with erythemato-ceruminous otitis externa: A randomized, multicentric, single-blinded, controlled trial. Vet Dermatol. 2023;35(2): 197-206.
24. Léonard C, Taminiau B, Ngo J, Fantini O, Daube G, Fontaine J. Preventive use of a topical anti-inflammatory glucocorticoid in atopic dogs without clinical sign of otitis does not affect ear canal microbiota and mycobiota. Vet Dermatol. 2021 Aug;32(4):355-e98.
25. Pye C, Yu A, Weese JS. Evaluation of biofilm production by Pseudomonas aeruginosa from canine ears and the impact of biofilm on antimicrobial susceptibility in vitro. Vet Dermatol 2013:24(4):446-e99.
26. Chan WY, Hickey EE, Page SW, Trott DJ, Hill PB. Biofilm production by pathogens associated with canine otitis externa, and the antibiofilm activity of ionophores and antimicrobial adjuvants. J Vet Pharmacol Ther. 2019;42(6):682–692.