Oh, Oh Otitis:

Using Ear Cytology to Guide Clinical Management of Chronic Otitis

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Conflict of Interest Disclosure:

I have financial interest, arrangement or affiliation with IDEXX Laboratories, Inc:

Full-time employee, Medical Consulting Services Dermatology

The information contained herein is intended to provide general guidance only. As with any diagnosis or treatment you should use clinical discretion with each patient based on a complete evaluation of the patient, including history, physical exam and presentation, and laboratory data. With respect to any drug therapy or monitoring program, you should refer to applicable product insert(s) for complete description of dosage, indications, interactions, and cautions. Diagnosis, treatment, and monitoring should be patient specific and is the responsibility of the veterinarian providing primary care. (2024)

Learning Objectives

1. Prevalence of otitis and the PPSP system
2. Importance of history and examination
3. Otic diagnostics for diagnosis and monitoring
4. Treatment protocol considerations
5. How to handle persistent and recurrent infections

Chronic Otitis:

Clinical Approach and Case Evaluation

Definitions

Ear infection	• Dysbiosis (overgrowth) vs infection (leukocytes)
Otitis externa	• Inflammation of the vertical and/or horizontal canal
Otitis media	• Inflammation of the tympanic cavity and membrane
Otitis interna	• Inflammation of the membranous and bony labyrinth

Sources:

1. Jangi Bajwa, Canine otitis externa. Can Vet J 2019 Jan 60 (1): 97-99
2. Tim Nuttall, PhD, MRCVS, Managing recurrent otitis externa in dogs: what have we learned and what can we do better? JAVMA , Vol 261, NO. S1, June 2023, S10-S22
3. Manolis Saridomichelakis, Rania Farmaki, Leonidas Leontides, Alexander Koutinas, Aetiology of canine otitis externa: a retrospective study of 100 cases. Veterinary Dermatology , Oct 2007. 18; issue 5; 285-388 - -341-347 Published in World Congress Proceedings p 165

Chronic Otitis

- Greater than 3 months duration
- History of underlying skin/ear disease
- Acquired proliferative changes to canal(s) and pinna(e)
- 75% secondary to underlying allergies

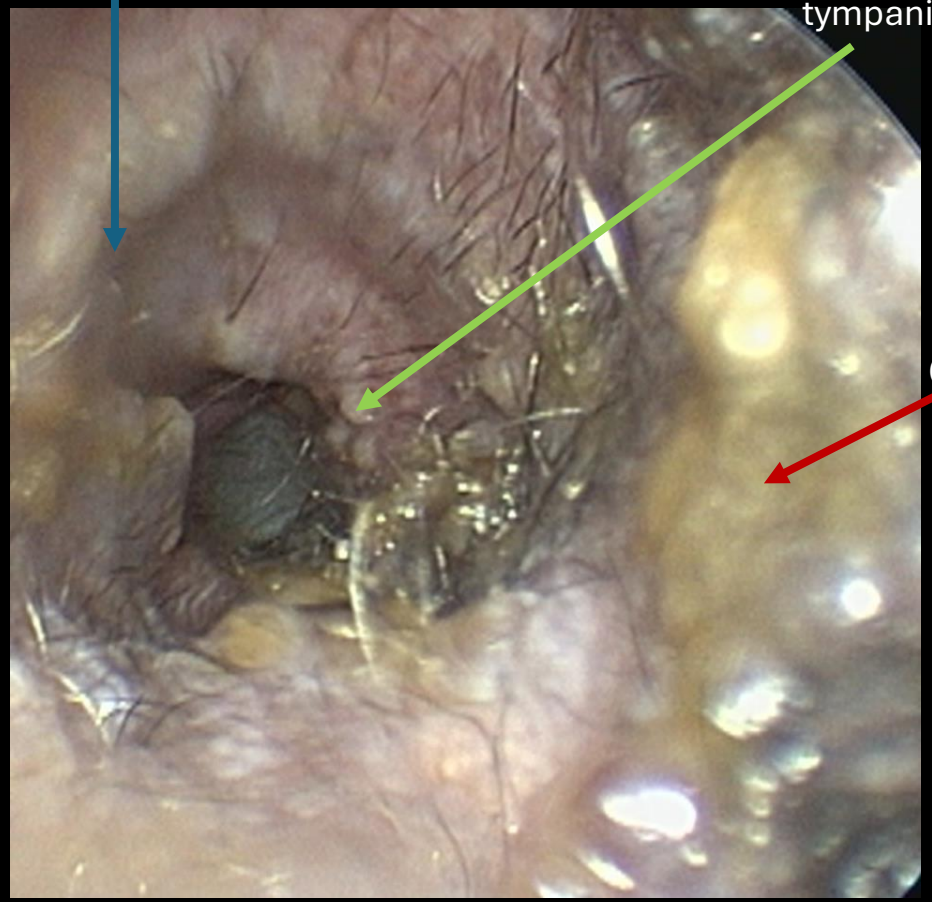


Image courtesy of Christina Gentry, DVM, DACVD, TAMU Teaching Collection

Source:
1. Bajwa J. Canine otitis externa - Treatment and complications. Can Vet J. 2019 Jan;60(1):97-99. PMID: 30651659; PMCID: PMC6294027.
2. Harvey BVSc DVD Dip ECVD FSB, R.G., & Paterson, S. (2014). Medical Management of Ear Diseases. In: Otitis Externa: An Essential Guide to Diagnosis and Treatment, 1st edn. CRC Press, Boca Raton, pp 81-103.

Classifying Otitis Externa: The PPSP System

Primary Cause(s)

Trigger inflammation

Predisposing Factor(s)

Allow inflammation

Secondary Cause(s)

Occur in combination with inflammation

Perpetuating Factor(s)

Maintain inflammation

Source:
1. Koch S. The challenge of chronic otitis in dogs—from diagnosis to treatment. *Today's Vet Pract*. 2017;7(3):60–70

PPSP System

Primary

- Hypersensitivities
  - **Allergic disease**
- Parasites
- Foreign body
- Space-occupying lesion
- Keratinizing disorders
- Endocrine
- Autoimmune

Predisposing

- Conformation
- Excessive moisture
- Inappropriate treatment
- Upper respiratory infections (cats)

Secondary

- Bacteria
  - ***P. aeruginosa***
- *Malassezia*
- **Biofilm**

Perpetuating

- **Epidermal and glandular hyperplasia**
- Stenosis
- **Otitis media**
- Tympanic membrane abnormalities
- Cholesteatoma formation

Sources:

1. Nuttall T. Managing recurrent otitis externa in dogs: what have we learned and what can we do better? J Am Vet Med Assoc. 2023 Apr 7;261(S1):S10-S22. doi: 10.2460/javma.23.01.0002.
2. Koch S. The challenge of chronic otitis in dogs—from diagnosis to treatment. *Today's Vet Pract*. 2017;7(3):60–70
3. Saridomichelakis MN, Farmaki R, Leontides LS, Koutinas AF. Aetiology of canine otitis externa: a retrospective study of 100 cases. Vet Dermatol. 2007 Oct;18(5):341-7. doi: 10.1111/j.1365-3164.2007.00619.x. PMID: 17845622.

Consequences of Repeat Infections

- Permanent canal changes
- Pain
- Aversion to ears being touched/cleaned
- Antimicrobial resistance
- Otitis media (hearing loss, nerve damage)
- Reduced quality of life
- More challenging to treat
- Expensive

Basic Otoscopic Examination

- History
- Bilateral
- External pinnae
- Horizontal and vertical canals:
  - Discharge
  - Hyperemia
  - Thickened walls
  - Calcification
  - Stenosis
  - Space occupying lesions
- Tympanic membrane

Image courtesy of Christina Gentry, DVM, DACVD, TAMU Teaching Collection

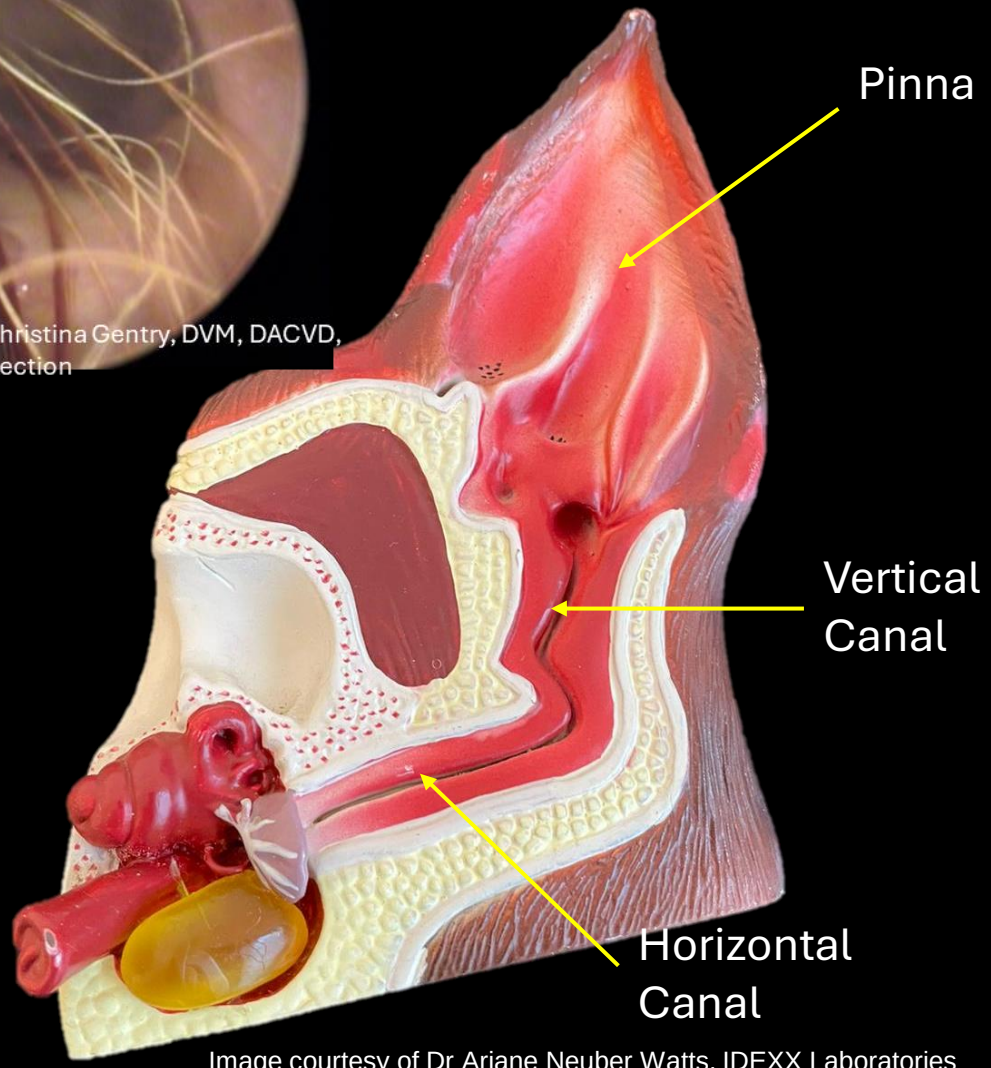


Image courtesy of Dr Ariane Neuber Watts, IDEXX Laboratories

Imaging

Study: Occult Otitis Media in Dogs with Chronic Otitis Externa

- Retrospective and prospective study
- 123 MRI studies
- 21% occult otitis media
- 15% intact tympanic membrane
- 39% ruptured tympanic membrane
- 34% not visible tympanic membrane
- Increased incidence of otitis media when rods and inflammatory cells present to rods alone

Occult otitis media is prevalent in chronic otitis externa

Source:

1. Lorek A, Dennis R, van Dijk J, Bannoehr J. Occult otitis media in dogs with chronic otitis externa - magnetic resonance imaging and association with otoscopic and cytological findings. Vet Dermatol. 2020 Apr;31(2):146-153. doi: 10.1111/vde.12817. Epub 2019 Dec 19. PMID: 31858646.

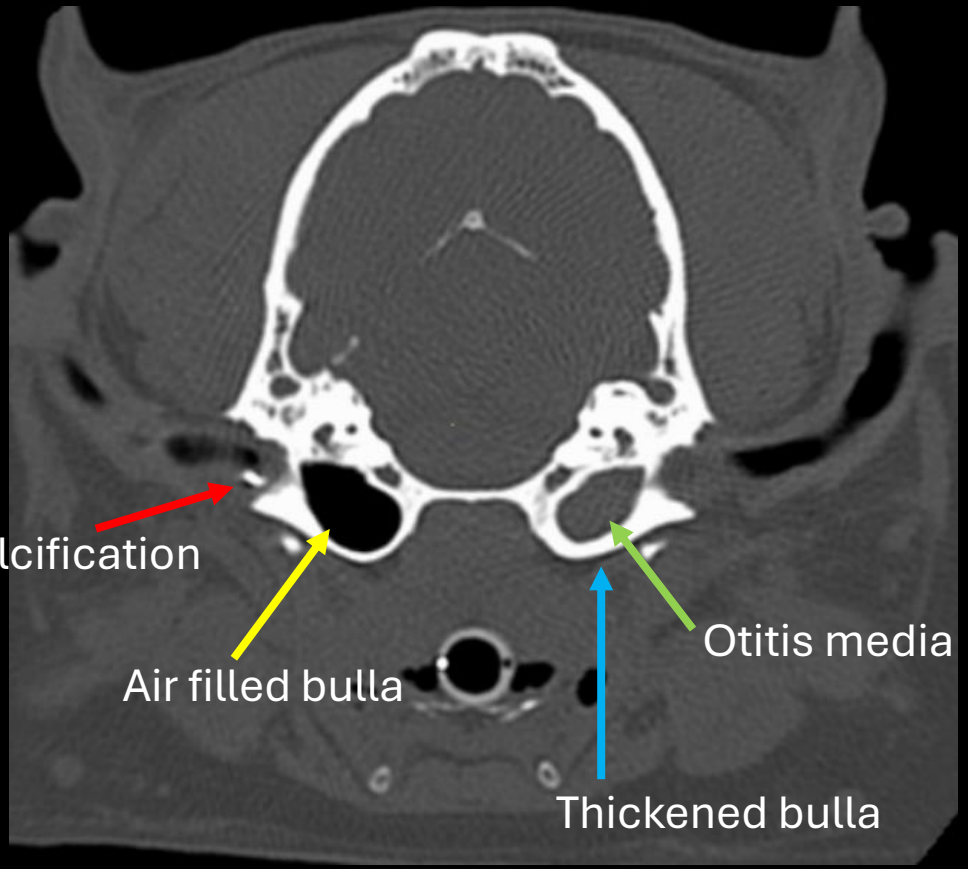
Imaging

Advantage and disadvantages of diagnostic imaging techniques

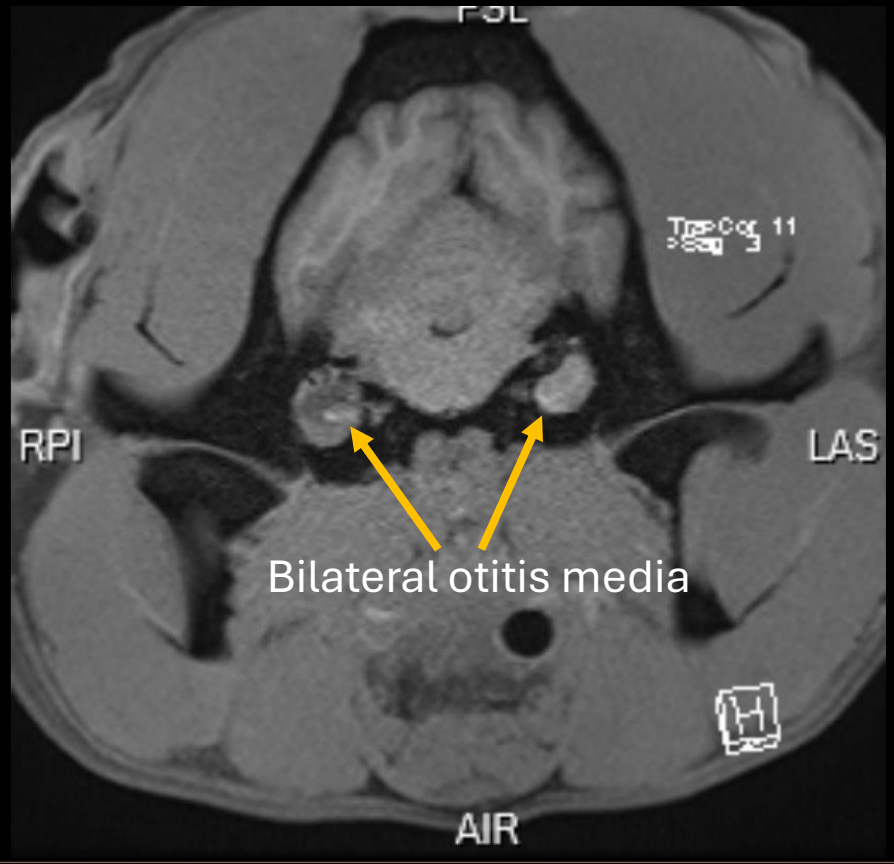
Diagnostic imaging techniques	Advantages	Disadvantages
Radiography	• Can detect mineralization and neoplasia in the ear canal and bony changes in the bulla wall • Usually does not require sedation, general anesthesia, or intravenous contrast material	• Has limited value in identifying soft tissue changes • Cannot rule out otitis media • Cannot distinguish between fluid and tissue in the middle ear • Not as sensitive as CT and MRI for predicting presence and severity of middle ear disease, such as otitis media
Ultrasonography	• Relatively quick and noninvasive • Can detect thickening and fluid in tympanic bulla • Usually does not require sedation or general anesthesia	• Cannot distinguish between fluid and tissue in the middle ear
Computed tomography (CT)	• Provides excellent images of bony structures and can differentiate bony changes in bullae from soft tissue reactions • Can detect presence of fluid in tympanic bulla (i.e., otitis media) • Can detect otitis interna, tumors, and meningitis	• Requires general anesthesia and administration of intravenous contrast material • Not as sensitive as MRI for identifying otitis interna, tumors, and meningitis • Expensive
Magnetic resonance imaging (MRI)	• Better for assessing soft tissue structures of external ear, inner ear, adjacent neural structures, and brain • Can detect fluid in tympanic bulla (i.e., otitis media) and otitis interna • Can detect tumors and their specific location, as well as meningitis	• May not identify mineralization of the external canals unless it is severe • Requires general anesthesia and administration of intravenous contrast material • Expensive

Source:
1. Koch S. The challenge of chronic otitis in dogs—from diagnosis to treatment. *Today's Vet Pract*. 2017;7(3):60–70.

CT Scan



MRI Scan



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Study: Computed tomographic findings in 205 dogs with clinical signs compatible with middle ear disease: a retrospective study

- 214 ears with chronic otitis externa
  - 40.7% with chronic otitis externa had CT abnormalities
  - 17.7% had material in the bullae
  - 19.6% had thickened bullae walls
  - 3.2% had bony lysis of the bulla
- 57% with suppurative otitis had changes
- 23% with erythemato-ceruminous otitis had changes
- 68% of otitis media cases had proliferative changes

Think otitis media with proliferative and suppurative ears!

Source:
1. 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. doi: 10.1111/vde.12503. Epub 2017 Oct 10. PMID: 28994490.

Cytology

Image courtesy of Elizabeth A. Layne, DVM, DACVD, Sandy, UT

Image from IDEXX inVue Dx™ Cellular Analyzer

Image courtesy of Elizabeth A. Layne, DVM, DACVD, Sandy, UT

Cytology Options

Modified Wright (Diff-Quik®)

- Does not differentiate **Gram-positive** vs **Gram-negative**
- Cocci versus rods versus yeast
- Inflammatory cells
- Fairly simple and faster than Gram stain
- Heat fixation for cerumen
- 3-step stain
- High-dry 40× objective versus oil immersion 100× objective

Gram stain

- Differentiates **gram-positive** vs **gram-negative**
- Cocci vs rods vs yeast
- Inflammatory cells
- More intensive steps and takes longer than Diff-Quik
- High-dry 40× objective versus oil immersion 100× objective
- Variable in clinic availability

Reference lab clinical pathology

- More expensive
- Subjective
- Must request quantification
- Diff-Quik or Gram stain
- Several-day turnaround

Benefits of Cytology

- Types of organism(s) and cellular content
  - Most sensitive method for diagnosing *Malassezia*
  - Leukocytes, red blood cells, acanthocytes
- In vivo subjective quantification
  - Infection vs overgrowth
  - Response to therapy
  - Determine need for culture
  - Compliments culture and sensitivity testing
- Guides empiric treatment and duration
- Point of care

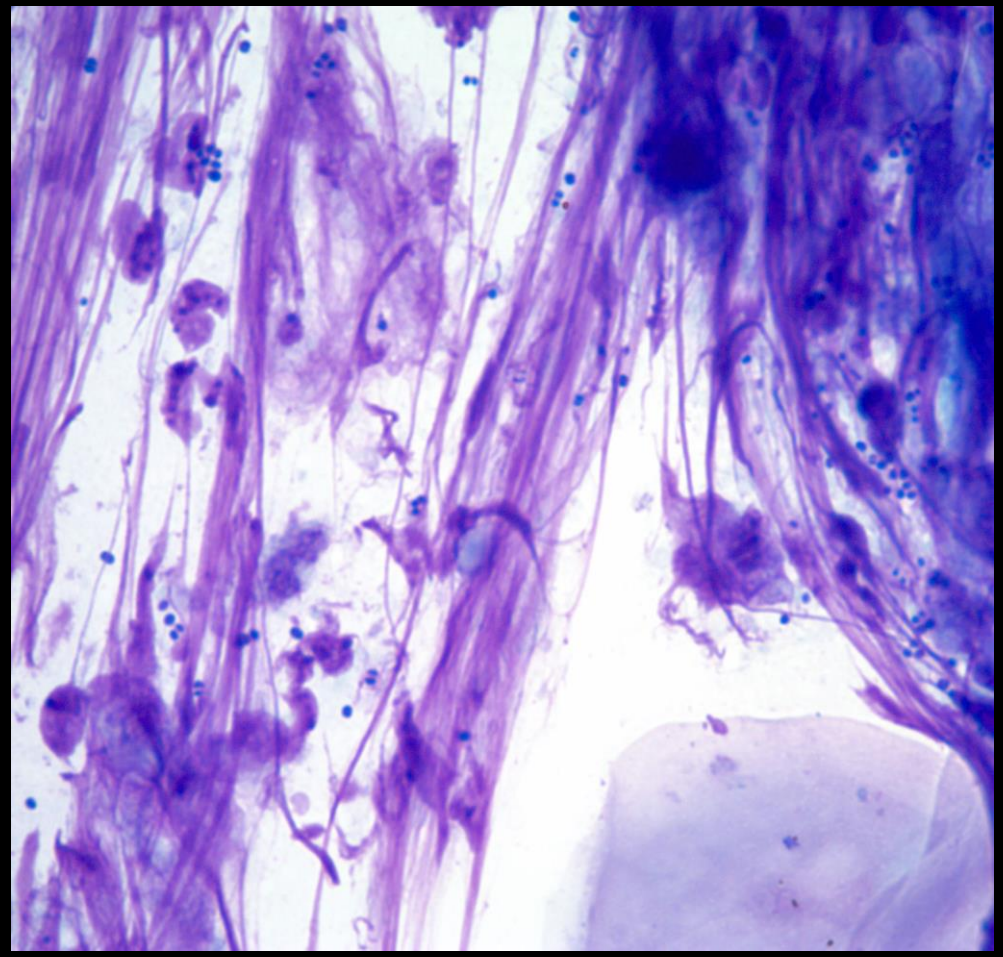
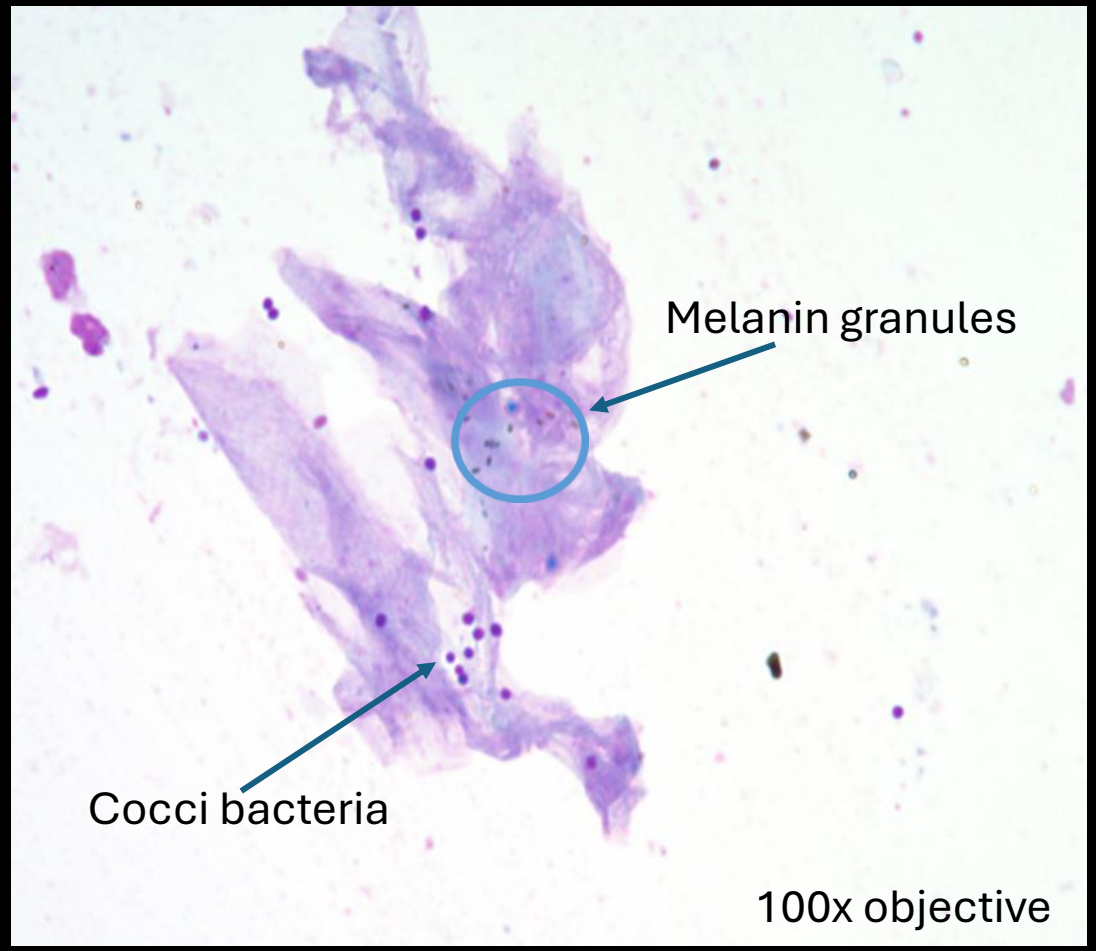


Image courtesy of Christina Gentry DVM, DACVD, TAMU Dermatology Teaching Collection

Source:
1. John C Angus, DVM, Otic cytology in healthy and disease, Veterinary Clinics of North America: Small Animal Practice, Volume 34, Issue 2, March 2004, Pages 411-424.

Cytology Pitfalls

- Need for trained staff
- Evaluation can be challenging
  - Rods versus melanin granules
  - Cocci versus stain precipitant
- Subjective interpretation
  - Variations between staff
- Mite preps are a separate process



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Subjective Cytologic Scoring

	Normal	Gray zone	Abnormal
Malassezia			
Dog	≤ 2	3–4	≥ 5
Cat	≤ 2	3–11	≥ 12
Bacteria			
Dog	≤ 5	6–24	≥ 25
Cat	≤ 4	5–14	≥ 15

Recommended criteria for evaluating the significance of organisms present on otic cytology (based on mean number of organisms per high-dry 40× field of view)

Source:
1. Ginel PJ, Lucena R, Rodriguez JC, Ortega J. A semiquantitative cytological evaluation of normal and pathological samples from the external ear canal of dogs and cats. *Vet Dermatol*. 2002;13(3):151–156. doi:10.1046/j.1365-3164.2002.00288.x

Semiquantative Cytologic Scales

Classification	Description
Rare	1–3 organisms per *entire slide*
Occasional	Average of 1–5 organism per OIF
1+	Average of 6–10 organism per OIF
2+	Average of 11–20 organism per OIF
3+	Average of 21–30 organism per OIF
4+	Average of 31–40 organism per OIF
TNTC (too numerous to count)	Massive amount of organisms per OIF you can't possibility count them; rapidly detected without difficulty

Abbreviation: OIF is for oil immersion field.

Source: Goal two: skin and ear cytology. In: Ohio State University College of Veterinary Medicine. *OSU CVM Veterinary Clinical and Professional Skills Center Handbook*. 2018. Accessed September 4, 2024. https://ohiostate.pressbooks.pub/osuvcpslhandbook/chapter/derm_exam-basic-techs_goal-two/

Cytology scale

0 = No bacteria/yeast/inflammatory cells present

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 easily detectable

3+ = Bacteria/yeast/inflammatory cells present in larger numbers and quickly and easily detectable

4+ = Massive amount of bacteria/yeast/inflammatory cells present and quickly and easily detectable

Source: *Clinician's Brief, Clinical Skills, Dermatology*, May 2013. https://www.cliniciansbrief.com/article/standard-cytology-scale-what-your-practice
Source Reproducibility of a semiquantitative method to assess cutaneous cytology. Budach SC, Mueller RS. VET DERMATOL 23:426-e80, 2012.

Mite Preparation

Ear mites seen via the IDEXX inVue Dx™ Cellular Analyzer

- Black, coffee ground debris
- Ceruminous debris
- Comedones
- Mites on examination (movement)
- Young patient
- Immunocompromised patients
- Inflammatory cells, no organisms
- Lack of response to treatment

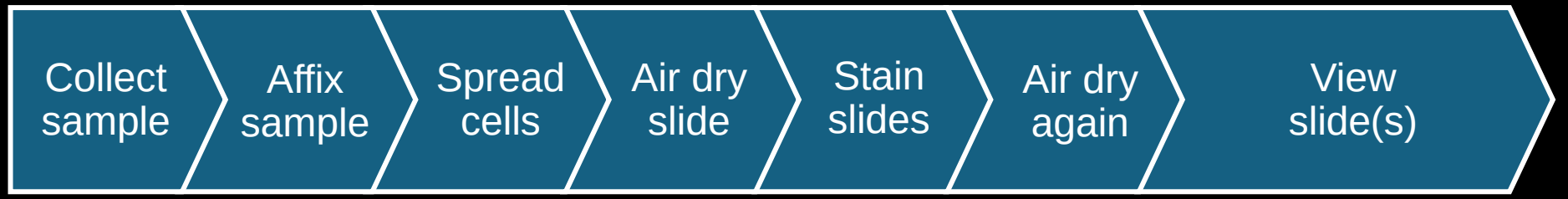
A New Innovation in Ear Cytology

Gives Time Back to Practices

Microscope

Often interrupted, multiple slides created

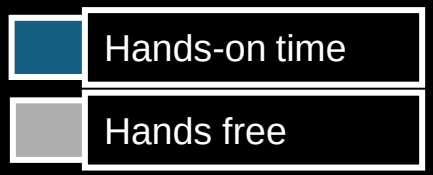
~10–20 minutes for prep



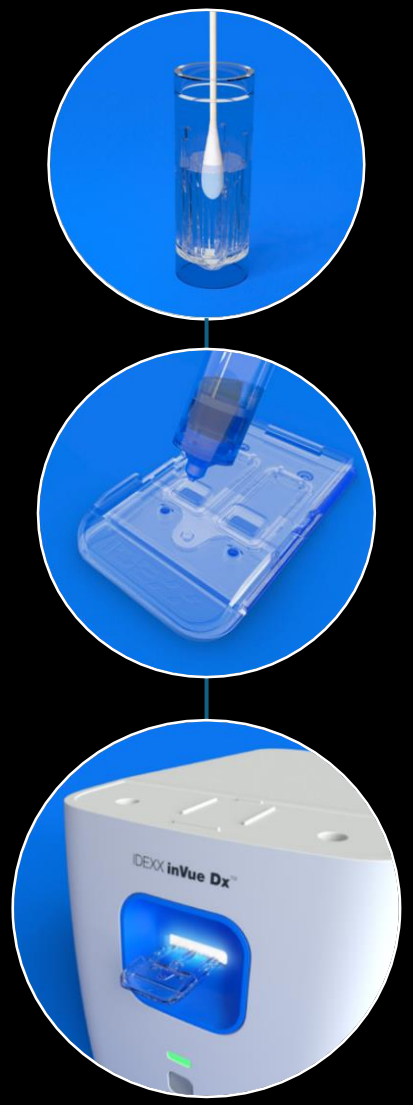
IDEXX inVue Dx™

~1 minute

10 minutes



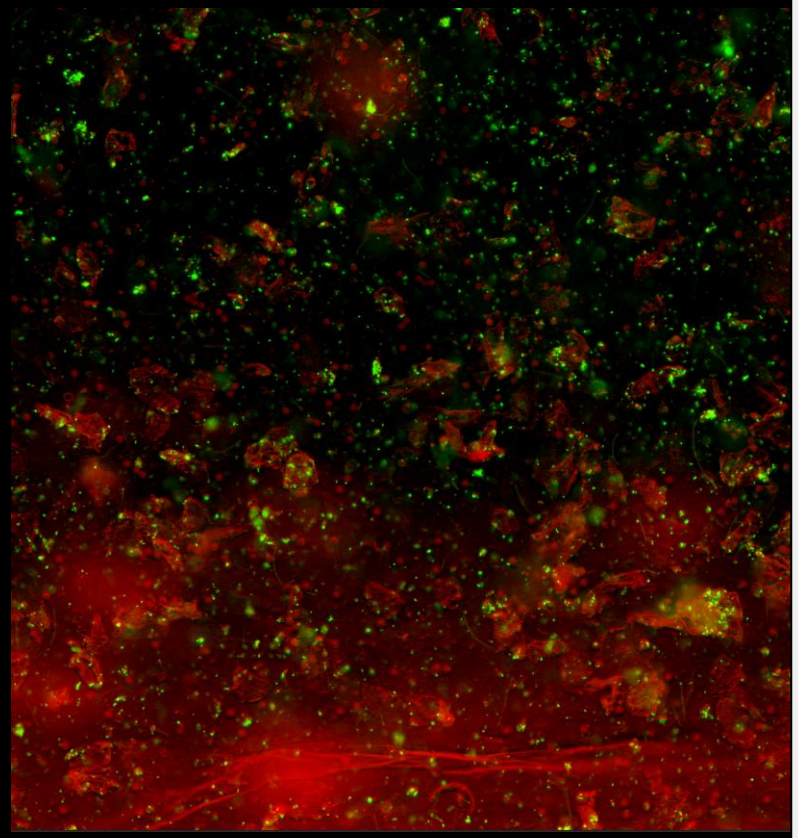
IDEXX inVue Dx™ analyzer: workflow

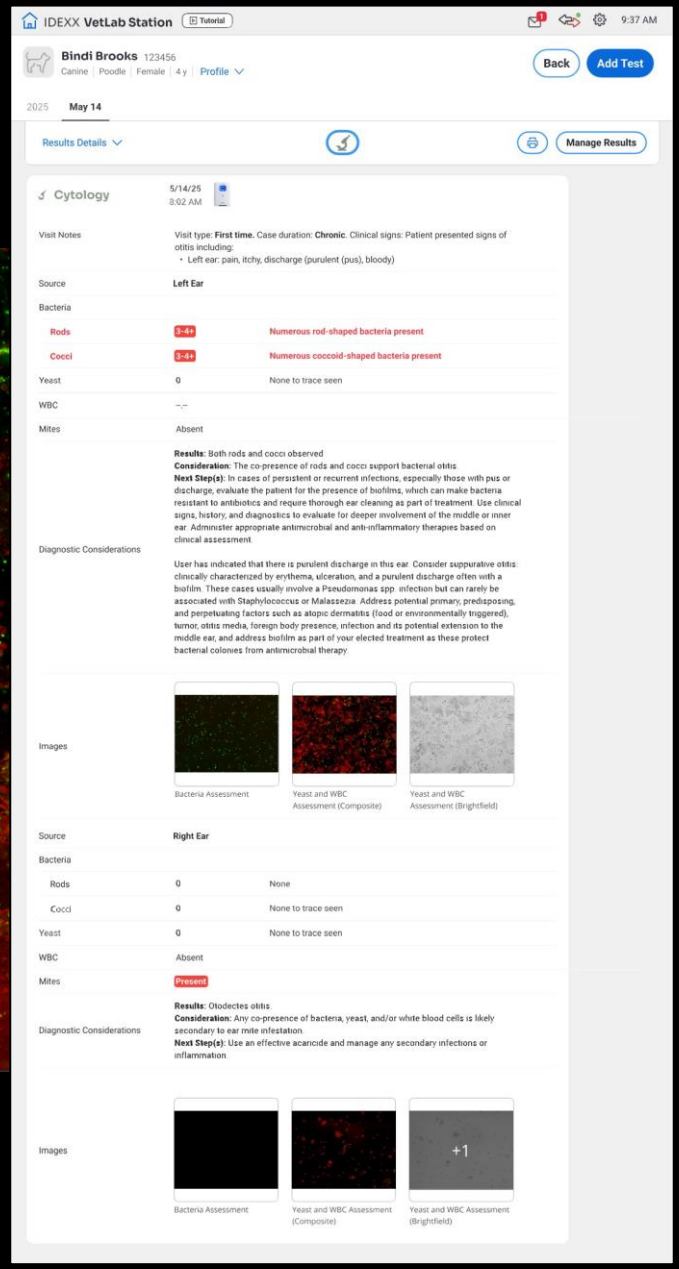


1. Put sample in the reagent
2. Drop sample into cartridge
3. Insert and press the Start button

IDEXX inVue Dx™ Cellular Analyzer

- Semiquantative Results
  - Rod-shaped bacteria
  - Cocci- shaped bacteria
  - Yeast
- Presence detected
  - Mites
  - White blood cells





IDEXX inVue Dx™ Cellular Analyzer

Revolutionary workflow

Slide-free, load-and-go

Plug-and-play integration

Pay-per-run

Deeper insights

High-value menu

Consistent and objective results

Advanced optics, deep learning AI

Cultures

Indications to Culture

- Chronic bacterial otitis externa
  - History of multidrug-resistant bacteria
  - Previous long-term therapy and history of failure
    - Persistent bacteria despite appropriate therapy
- Otitis media
  - Rods and leukocytes on cytology
  - Culture from middle ear
    - Deep ear flush then myringotomy if needed
  - Selection of systemic therapy
  - Organisms in middle and external ear may vary

Sources:
1. Angus JC. Otic cytology in health and disease. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):411-24. doi: 10.1016/j.cvsm.2003.10.005)
2. Cole LK, Kwochka KW, Kowalski JJ, Hillier A. Microbial flora and antimicrobial susceptibility patterns of isolated pathogens from the horizontal ear canal and middle ear in dogs with otitis media. J Am Vet Med Assoc. 1998 Feb 15;212(4):534-8. PMID: 9491161.
3. Nuttall T. Managing recurrent otitis externa in dogs: what have we learned and what can we do better? J Am Vet Med Assoc. 2023 Apr 7;261(S1):S10-S22. doi: 10.2460/javma.23.01.0002

Culturing Challenges

- Inability to distinguish normal flora, overgrowth, or true infection
- Culture growth doesn't equal in vivo quantification
  - Hard to assess response to therapy
- Susceptibility testing is based on systemic not topical concentrations
  - Difference of mcg/ml and mg/ml
- Different isolates in canal and bullae
- Repeat cultures may grow different bacteria
- All organisms may not grow

Sources:
1. Angus JC. Otic cytology in health and disease. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):411-24. doi: 10.1016/j.cvsm.2003.10.005)
2. Cole LK, Kwochka KW, Kowalski JJ, Hillier A. Microbial flora and antimicrobial susceptibility patterns of isolated pathogens from the horizontal ear canal and middle ear in dogs with otitis media. J Am Vet Med Assoc. 1998 Feb 15;212(4):534-8. PMID: 9491161.
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4. Graham-Mize CA, Rosser EJ. Comparison of microbial isolates and susceptibility patterns from the external ear canal of dogs with otitis externa. *JAAHA* 2004;40(2):102-108.

Study: Microbial flora and antimicrobial susceptibility patterns of isolated pathogens from the horizontal ear canal and middle ear in dogs with otitis media

- Prospective study
- 23 dogs with chronic bilateral otitis externa
- 82.6% had otitis media
- 71.7% **intact** tympanic membrane
- 89.5% had varying isolates or susceptibility in compared cultures from the horizontal canal and bulla

Bulla cultures are needed for treatment of otitis media.

Source:
1. Cole LK, Kwochka KW, Kowalski JJ, Hillier A. Microbial flora and antimicrobial susceptibility patterns of isolated pathogens from the horizontal ear canal and middle ear in dogs with otitis media. J Am Vet Med Assoc. 1998 Feb 15;212(4):534-8. PMID: 9491161.

Study: Comparison of microbial isolates and susceptibility patterns from the external ear canal of dogs with otitis externa

- 33 dogs, 100 samples
- Objectives:
  - Comparison of cytology and culture results
  - Comparison of paired cultures from the ear canal
- 36% isolated 1 organism
  - 21 *Malassezia* spp
- 23% isolated 2 organisms
- 80% agreement in paired cultures
- 68% agreement in cytologic and culture results

Treatment failures could be due to bacteria that didn't culture or varied susceptibility.

Sources:
1. Graham-Mize CA, Rosser EJ. Comparison of microbial isolates and susceptibility patterns from the external ear canal of dogs with otitis externa. *JAAHA* 2004;40(2):102-108.

Common Bacterial Isolates

Normal external canal	Otitis externa	Otitis media
Coag (−) *Staphylococcus*	Coag (+) *Staphylococcus*	Coag (+) *Staphylococcus*
Coag (+) *Staphylococcus*	β-hemolytic *Streptococcus*	β-hemolytic *Streptococcus*
β-hemolytic *Streptococcus*	*Pseudomonas* spp.	*Pseudomonas* spp.
Corynebacteria spp.	*Proteus* spp.	*Proteus* spp.
Coliforms	Coliforms	Coag (−) *Staphylococcus*
	Coag (−) *Staphylococcus*	Coliforms
	Corynebacteria spp.	α-*Streptococcus*
		Enterococcus

Abbreviation: Coag is for coagulase.

Source:
1. Angus JC. Otic cytology in health and disease. *Vet Clin North Am Small Anim Pract*. 2004;34(2):411–424. doi:10.1016/j.cvsm.2003.10.005

Pseudomonas aeruginosa

- Common cause of otitis externa and media
- Acute vs Chronic
  - Be aggressive
  - Chronicity leads to otitis media
  - Biofilms
- Steroids reduce secretions and inflammation

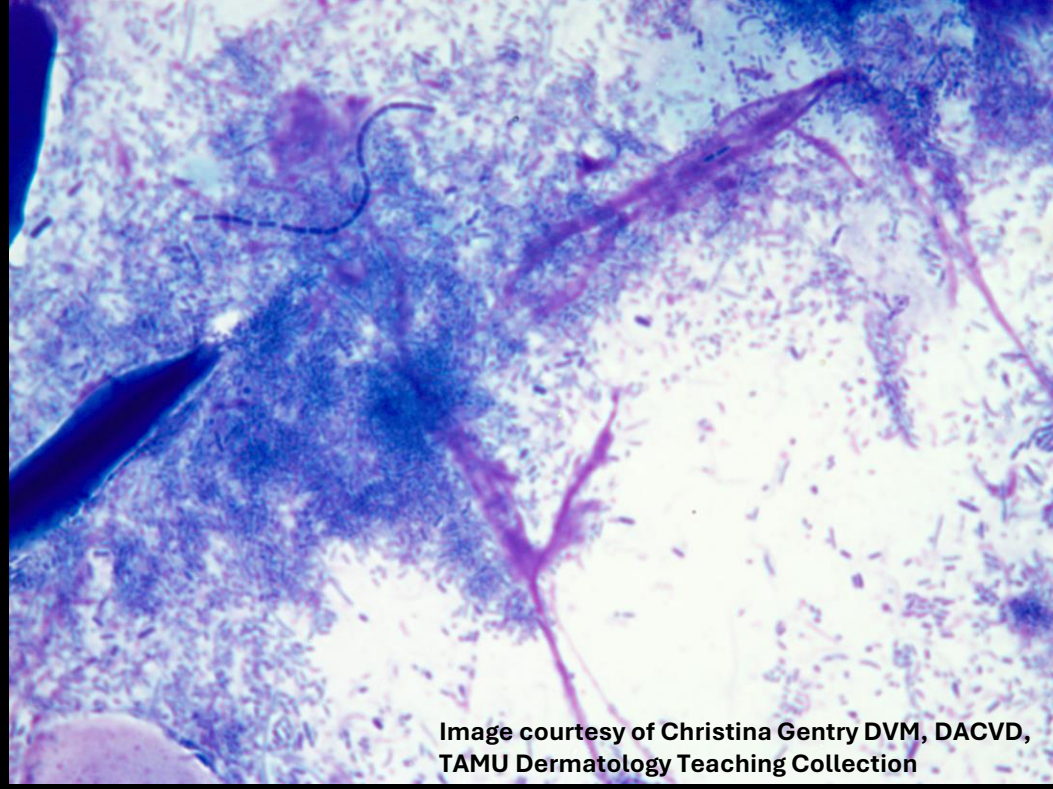

Image courtesy of Christina Gentry DVM, DACVD, TAMU Dermatology Teaching Collection

- Follow-up is necessary to determine therapeutic response
  - Cytology & clinical exam
  - Treat to full clinical & cytologic resolution

Sources:

1. Scott DW, Miller WH, Griffin CE. Diseases of eyelids, claws, anal sacs, and ears. In: Muller and Kirk's small animal dermatology. 6th edition. Philadelphia: WB Saunders; 2000. p. 1185–235.
2. Kiss G, Radványi S, Szigeti G. New combination for the therapy of canine otitis externa. I. Microbiology of otitis externa. J Small Anim Pract. 1997 Feb;38(2):51-6. doi: 10.1111/j.1748-5827.1997.tb02987.x. PMID: 9065882.
3. Cole LK, Kwochka KW, Kowalski JJ, Hillier A. Microbial flora and antimicrobial susceptibility patterns of isolated pathogens from the horizontal ear canal and middle ear in dogs with otitis media. J Am Vet Med Assoc. 1998 Feb 15;212(4):534-8. PMID: 9491161.
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Biofilms

- Treatment challenges
  - Difficult to penetrate
  - Persistence and recurrence
- Remove by flushing
  - N-acetyl cystine[3]
    - Damage biofilms, Lowered MIC
    - Indifferent to antagonistic with enrofloxacin and gentamicin[6]
  - Chlorhexidine, polihexanide, hypochlorous acid[4,5], and tris-EDTA[3]
- *Pseudomonas* spp.
- *Staphylococcus* spp.
- *Malassezia* spp.

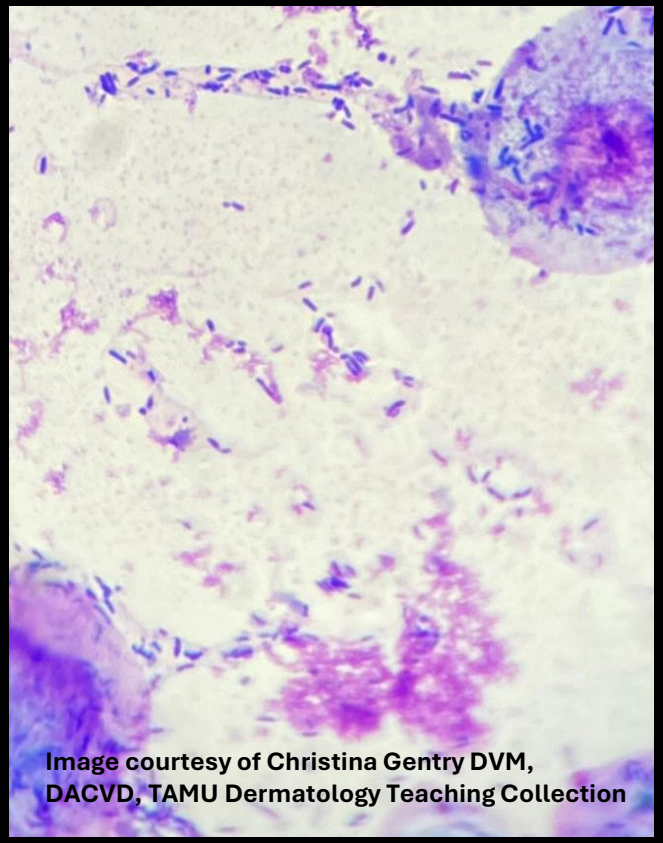

Image courtesy of Christina Gentry DVM, DACVD, TAMU Dermatology Teaching Collection

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1. Nuttall T. Managing recurrent otitis externa in dogs: what have we learned and what can we do better? J Am Vet Med Assoc. 2023 Apr 7;261(S1):S10-S22. doi: 10.2460/javma.23.01.0002. PMID: 37019436.
2. Robinson VH, Paterson S, Bennett C, Steen SI. Biofilm production of Pseudomonas spp. isolates from canine otitis in three different enrichment broths. Vet Dermatol. 2019 Jun;30(3):218-e67. doi: 10.1111/vde.12738. Epub 2019 Mar 21. PMID: 30895679.
3. 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 Nov;42(6):682-692. doi: 10.1111/jvp.12811. Epub 2019 Sep 10. PMID: 31503362.
4. Mueller RS, Baumann KN, Boehm T, Dörfelt S, Kasper B, Udraite-Vovk L. Evaluation of hypochlorous acid as an ear flush in dogs with chronic otitis externa. Vet Dermatol. 2023 Apr;34(2):134-141. doi: 10.1111/vde.13142. Epub 2022 Dec 14. PMID: 36517454.
5. Sakarya S, Gunay N, Karakulak M, Ozturk B, Ertugrul B. Hypochlorous Acid: an ideal wound care agent with powerful microbicidal, antibiofilm, and wound healing potency. Wounds. 2014 Dec;26(12):342-50. PMID: 25785777.
6. May ER, Ratliff BE, Bemis DA. Antibacterial effect of N-acetylcysteine in combination with antimicrobials on common canine otitis externa bacterial isolates. Vet Dermatol. 2019 Dec;30(6):531-e161. doi: 10.1111/vde.12795. Epub 2019 Oct 31. PMID: 31670428.

Eliminate Discomfort and Pain

- Glucocorticoids
  - Reduce inflammation
  - Decrease pain
    - Topical
      - Dexamethasone, betamethasone, mometasone, hydrocortisone aceponate
      - Can suppress the hypothalamic-pituitary –adrenal axis
    - Systemic
      - Prednisone, prednisolone
  - Daily then taper
- Cyclosporine
- Ilunocitinib
  - Over 12 months of age

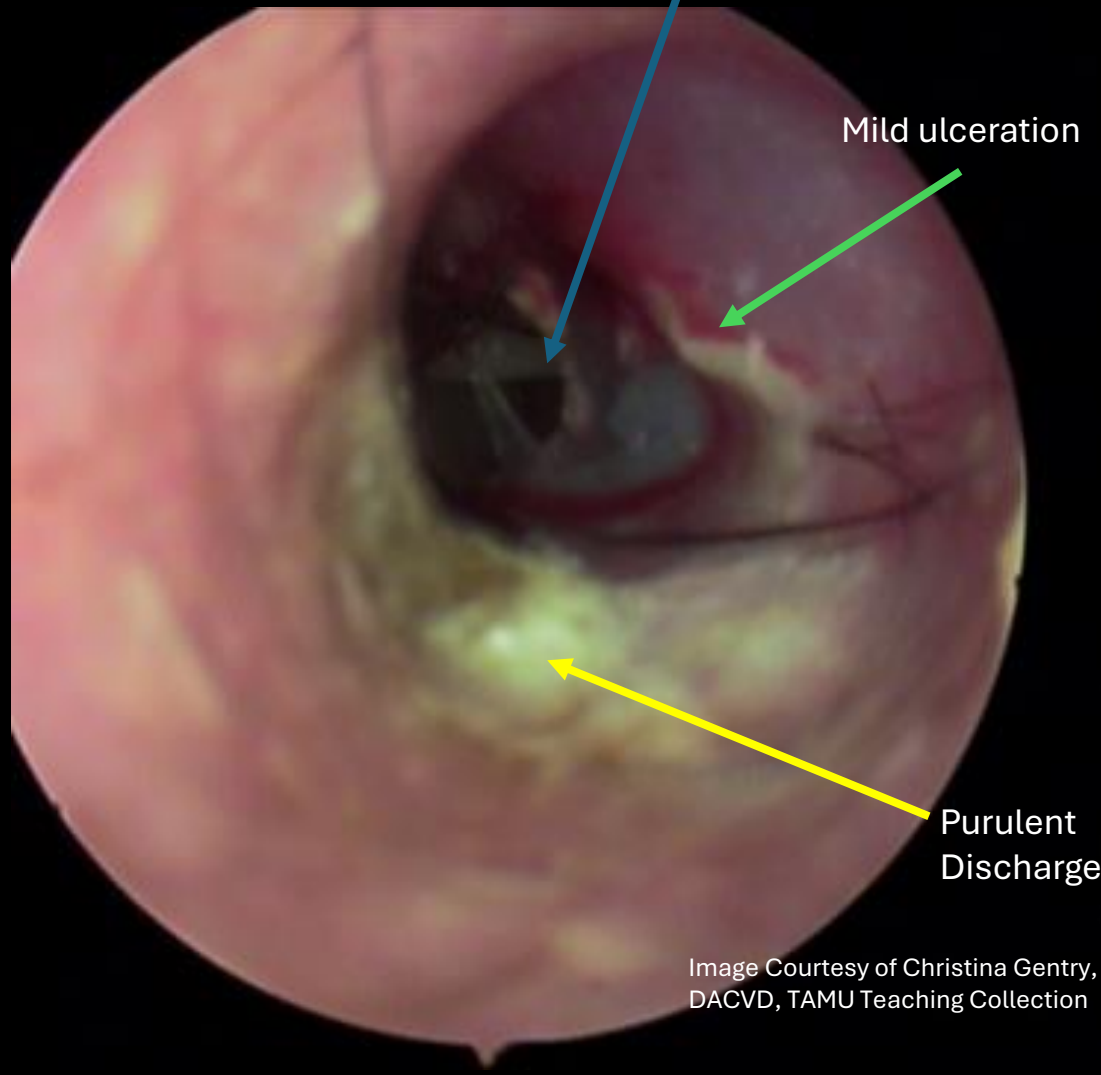

Image Courtesy of Christina Gentry, DVM, DACVD, TAMU Teaching Collection

Sources:
1. Nuttall T. Managing recurrent otitis externa in dogs: what have we learned and what can we do better? J Am Vet Med Assoc. 2023 Apr 7;261(S1):S10-S22. doi: 10.2460/javma.23.01.0002. PMID: 37019436.
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Deep Ear Cleaning

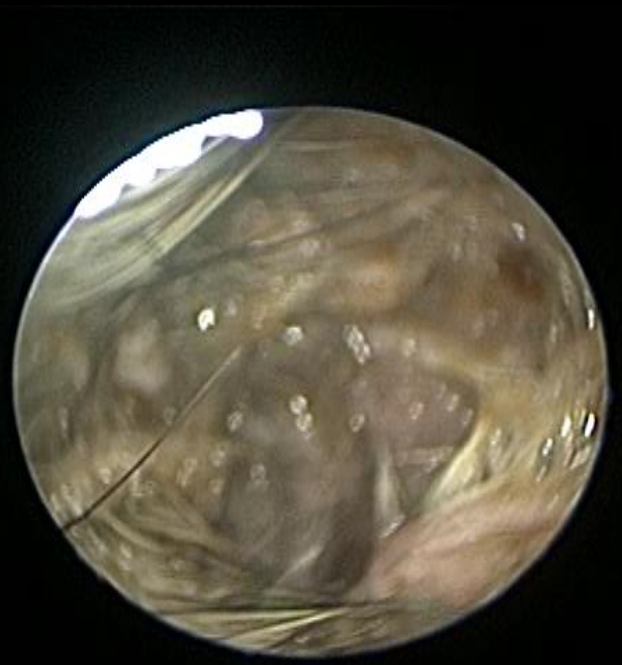

Image courtesy of Ariane Neuber Watts, DrMedVet, DECVD, IDEXX Laboratories

Pretreatment- Ceruminolytics

- Soft waxy debris
  - Ingredient: Dioctyl sodium sulfosuccinate (DSS) or propylene glycol (ototoxicity)
- Hard waxy debris
  - Ingredient: Squalene (unlikely to be ototoxic)
- AVOID in cats

Flush

- Isotonic (0.9%) saline
  - Warm to body temperature
- New bulb syringe

Don't occlude the canal!

Video otoscopy/Handheld otoscope

- 20 ml syringe/12 ml syringe
- 5 -French / 8-French polypropylene catheter

Evaluate the tympanic membrane

- Suction canal for visibility
- Culture and cytology if ruptured, sterile otoscope cone
- Flush bulla with saline

Sources:

1. Gortel K. Otic flushing. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):557-65. doi: 10.1016/j.cvsm.2003.10.010. PMID: 15062624.
2. Mansfield PD, Steiss JE, Boosinger TR, Marshall AE. The effects of four, commercial ceruminolytic agents on the middle ear. J Am Anim Hosp Assoc. 1997 Nov-Dec;33(6):479-86. doi: 10.5326/15473317-33-6-479. PMID: 9358414.

Study: The susceptibility of *Pseudomonas* spp. isolated from dogs with otitis to topical ear cleaners

- Consistent in vitro efficacy[1]:
  - Acetic Acid
    - MOA: intracellular acidification
    - Previously described anti-Pseudomonal activity[2, 3, 4]
    - Safe in the middle ear[4]
  - Lactic Acid
    - MOA: Reduces pH & disrupts cell membrane[7]
    - Unknown ototoxicity
  - Chlorhexidine
    - MOA: Cell membrane disruption
    - Safe in middle ear at <0.2%[5,6]
      - BAER testing without threshold evaluations not performed[6]

Sources:
1. Steen, S.I. and Paterson, S. (2012), The susceptibility of *Pseudomonas spp*. isolated from dogs with otitis to topical ear cleaners. J Small Anim Pract, 53: 599-603. https://doi.org/10.1111/j.1748-5827.2012.01262.x
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4. Rosychuk, R. A. W. (1994) Mnagement of otitis externa. In: Veterinary Clinics of North America: Small Animal Practice 24, 921-952.
5. Merchant, S. R., Neer, T. M., Tedford, B. L., Tewdt, A. C., Cheramie, O. M. & Strain, G. M. (1993) Ototoxicity assessment of a chlorhexidine otic preparation in dogs. *Prog Vet Neurol* 4, 72-75.
6. Strain, G.M. (2018), Chlorhexidine. J Small Anim Pract, 59: 60-60. https://doi.org/10.1111/jsap.12789.
7. Alakomi HL, Skyttä E, Saarela M, Mattila-Sandholm T, Latva-Kala K, Helander IM. Lactic acid permeabilizes gram-negative bacteria by disrupting the outer membrane. Appl Environ Microbiol. 2000 May;66(5):2001-5. doi: 10.1128/AEM.66.5.2001-2005.2000. PMID: 10788373; PMCID: PMC101446.

Treatment

- Inflammation control
- Ear Flush
  - Debris removal
  - Biofilm disruption
- Antibiotics/Antifungals
  - Topical – otitis externa and media
  - Systemic –otitis media
    - Base on bulla culture
    - 6-8 week course
  - Duration to cytologic and clinical resolution
  - Malassezia- azoles
- Control of underlying conditions

Antibiotic Class	Spectrum of Activity
Aminoglycosides (AG)	• Bactericidal for gram-negative and Staphylococci • Aerobes
Fluoroquinolones (FQ)	• Gram-negative and gram-positive bacteria • Aerobes
Polymyxins	• Gram-negative bacteria • *Pseudomonas,* and *E. coli* • Aerobes
Phenicols	• Gram-negative bacteria- EXCLUDING *Pseudomonas* • Gram-positive bacteria
Sulfonamides	• Broad spectrum, variable efficacy • Some anti-yeast activity

Sources:
1. Morris DO. Medical therapy of otitis externa and otitis media. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):541-55, vii-viii. doi: 10.1016/j.cvsm.2003.10.009. PMID: 15062623.
2. Harvey BVSc DVD Dip ECVD FSB, R.G., & Paterson, S. (2014). Medical Management of Ear Diseases. In: Otitis Externa: An Essential Guide to Diagnosis and Treatment, 1st edn. CRC Press, Boca Raton, pp 81-103.
3. Shell LG. Otitis media and otitis interna. Etiology, diagnosis and medical management. Vet Clin North AM Small Anim Pract 1988; 18: 885-899.

Tris-EDTA

- Most effective in gram negative infections (*Pseudomonas*)
- Synergistic activity
  - Pretreat 10 minutes prior to medications
    - ~2.5 ml twice daily for 2 weeks, then daily
  - Aminoglycosides and fluoroquinolones
- Alkalizing buffer
- Chelates magnesium and calcium in bacterial cell walls
- Alters ribosomal stability
- Anti-biofilm activity

Sources:

1. Otitis Externa: An Essential Guide to Diagnosis and Treatment. By Richard G. Harvey and Sue Paterson, CRC Press, London, 2014, 162pp.
2. Vaara M. Agents that increase the permeability of the outer membrane. Microbiol Rev. 1992 Sep;56(3):395-411. doi: 10.1128/mr.56.3.395-411.1992. PMID: 1406489; PMCID: PMC372877.
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4. Buckley LM, McEwan NA, Nuttall T. Tris-EDTA significantly enhances antibiotic efficacy against multidrug-resistant Pseudomonas aeruginosa in vitro. Vet Dermatol. 2013 Oct;24(5):519-e122. doi: 10.1111/vde.12071. PMID: 24025021.

Otitis Media

- 50% of chronic otitis externa cases[1]
  - 21% oOccult otitis media[2]
- Suppurative inflammation
- +/- intact tympanic membrane
  - Ruptured- consider aqueous medications
- Horner's Syndrome
  - Head tilt, nystagmus, ataxia, miosis, elevated third eye lid
- Pain opening and closing mouth
- Hearing loss
- Culture based systemic antibiotics
  - 6-8 wks of treatment, 1-2 wks past resolution
- Topicals therapy for otitis externa

Elevated third eyelid

Miosis

Images courtesy of Christina Gentry DVM, DACVD, TAMU Dermatology Teaching Collection

Sources:

1. Jangi Bajwa, Canine otitis externa. Can Vet J 2019 Jan 60 (1): 97-99.
2. Lorek A, Dennis R, van Dijk J, Bannoehr J. Occult otitis media in dogs with chronic otitis externa - magnetic resonance imaging and association with otoscopic and cytological findings. Vet Dermatol. 2020 Apr;31(2):146-153. doi: 10.1111/vde.12817. Epub 2019 Dec 19. PMID: 31858646.

Recurrence versus Persistence:

- Struggling to clear the infection?
  - Persistence
  - Biofilm, otitis media, resistance, under dosing, compliance

- Coming back quickly within 4-8 weeks?
  - Recurrence
  - Otitis media

- Cleared for several months, now a new infection?
  - Recurrence
  - Uncontrolled primary factor(s)

End Stage Ear Disease

Chronic canal changes

- Epithelial and ceruminous gland hyperplasia
- Fibrosis
- Stenosis
- Calcification (permanent)

End-stage ears

- Firm, non-pliable, occluded canals
- Lack of response to steroids
- Radiograph evidence of marked calcification
- Minimal response to therapy, persistent infection

Surgical intervention

- Total ear canal ablation and bulla osteotomy (TECA-BO)
- Ventral bulla osteotomy (VBO)
- Lateral ear canal resection

Quality of Life

- Maintenance therapy
  - Glucocorticoids
  - Antimicrobial flushes
  - Antibiotic/antifungal treatment when affecting quality of life, but not maintenance

Treatment Pearls- Treatment

Treat to cytologic and clinical resolution

- Rechecks every 10-14 days
- Can take months to return the canal to normal
  - In a study by BA Palmeiro et al, mean duration to resolution for chronic otitis media in 44 dogs was 30-360 days
- Manage primary and secondary causes and predisposing and perpetuating factors

Sources:

1. Palmeiro BS, Morris DO, Wiemelt SP, Shofer FS. Evaluation of outcome of otitis media after lavage of the tympanic bulla and long-term antimicrobial drug treatment in dogs: 44 cases (1998-2002). J Am Vet Med Assoc. 2004 Aug 15;225(4):548-53. doi: 10.2460/javma.2004.225.548. PMID: 15344362.
2. Morris DO. Medical therapy of otitis externa and otitis media. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):541-55, vii-viii. doi: 10.1016/j.cvsm.2003.10.009. PMID: 15062623.

Treatment Pearls- Antimicrobials

Tris-EDTA

- **Pre-treat 10 minutes prior to aminoglycosides or fluoroquinolones**
- ***Pseudomonas aeruginosa***
- **May decrease efficacy of silver sulfadiazine (SSD)**

Tris-EDTA and Enrofloxacin are safe in the bulla

Enrofloxacin

- ***Pseudomonas aeruginosa* infection**
  - **Ideally based on culture and sensitivity**
- **Safe with ruptured tympanic membrane**
- **Safe with known contact hypersensitivity to other topicals**

Aminoglycosides

- **Neomycin- 1st line therapy**
- **Gentamicin- 2nd line therapy**
- **Amikacin and tobramycin- 3rd line therapy**
- **Contact hypersensitivities (neomycin most commonly)**
- **Ototoxicity**
  - **Flush with saline**
  - **Oftentimes resolves with time**
- **Nephrotoxicity**

Sources:

1. Boyd M, Santoro D, Gram D. In vitro antimicrobial activity of topical otological antimicrobials and Tris-EDTA against resistant Staphylococcus pseudintermedius and Pseudomonas aeruginosa isolates from dogs. Vet Dermatol. 2019 Apr;30(2):139-e40. doi: 10.1111/vde.12717. Epub 2019 Jan 23. PMID: 30672043.
2. Harvey, Richard G., and Sue Paterson. *Otitis Externa : An Essential Guide to Diagnosis and Treatment*. CRC Press/Taylor & Francis, 2014. [Kindle version]
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Treatment Pearls

Otitis media

- Recurrence within 4-8 wks
- Purulent discharge
- Ruptured tympanic membrane
- Deep ear flush
- Antibiotics:
  - Systemics for 6–8-wks
  - Topicals
    - 1% SSD if unresponsive *Pseudomonas*
    - 1-2 ml flush

Always protect the airway!

End stage otitis

- Comfort
  - Glucocorticoids
- Treat to stabilize
- Maintain with flushes
  - Acetic acid and squalene are safe in bullae
- Surgical intervention

Sources:

1. Boyd M, Santoro D, Gram D. In vitro antimicrobial activity of topical otological antimicrobials and Tris-EDTA against resistant Staphylococcus pseudintermedius and Pseudomonas aeruginosa isolates from dogs. Vet Dermatol. 2019 Apr;30(2):139-e40. doi: 10.1111/vde.12717. Epub 2019 Jan 23. PMID: 30672043.
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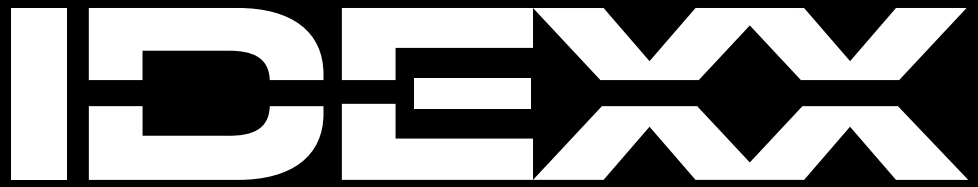
4. Morris DO. Medical therapy of otitis externa and otitis media. Vet Clin North Am Small Anim Pract. 2004 Mar;34(2):541-55, vii-viii. doi: 10.1016/j.cvsm.2003.10.009. PMID: 15062623.

Disclosure:

Catherine Metry is a full-time employee of IDEXX*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