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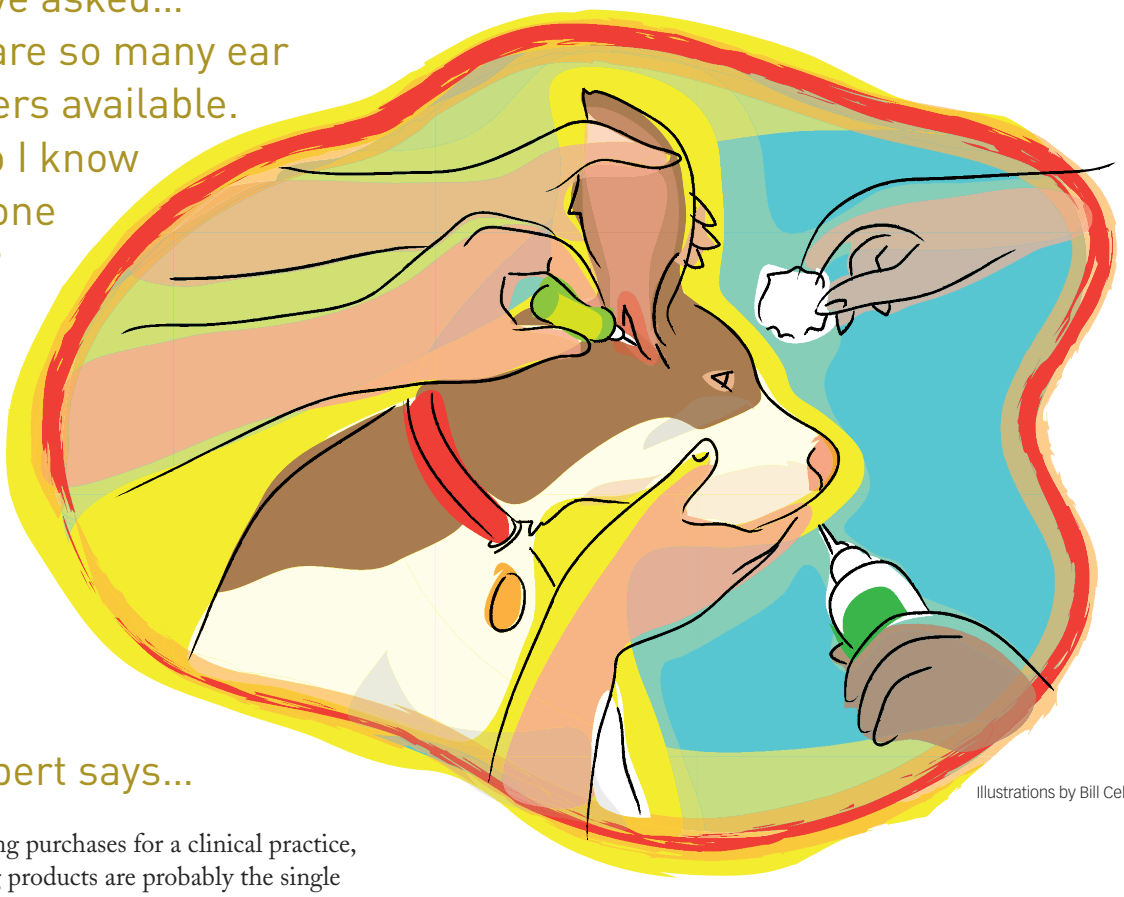
Winning the Ear Disease Fight

You have asked...

There are so many ear cleansers available. How do I know which one to use?



Illustrations by Bill Celander

The expert says...

When making purchases for a clinical practice, ear cleansing products are probably the single item with the most choices, so deciding which product to use for a particular case becomes that much more challenging.

Before considering which product might be best, however, the status of ear disease in a given patient needs to be determined (see **Diagnostic Measures for Evaluating Ear Disease**, page 30). But stocking your pharmacy with 10 to 15 different ear cleansers so you can meet individual patient needs is not good business (nor practical), so it is advisable to select a few product types with different functions that can be used in a variety of case scenarios.

There are many components that make up ear cleansers, which can be classified according to how the chemicals perform in the ear canal:

- **Detergents** (ceruminolytics) dewax the ear canal to allow easy removal of emulsified ear glandular secretions.
- **Acids** change the pH of the ear canal and inhibit growth and reproduction of many infectious organisms.
- **Alkalizers** promote and improve the function of antibiotics.

CONTINUES

Ear cleansing with the correct product is probably the single most important therapy for otitis.

Diagnostic Measures for Evaluating Ear Disease

Before selecting an ear-cleansing product, the status of ear disease needs to be determined by otoscopic examination, a comprehensive dermatologic evaluation, and ear canal cytology.

- An ear examination gives tips on the consistency of exudates, amount of waxy debris, texture of the epithelial lining, and presence or absence of the eardrum.
- A comprehensive dermatologic examination coupled with a detailed patient history may reveal the primary cause of ear disease.
- Cytology can guide selection of ear cleansers based on the presence of excessive squamous cells; infections with yeasts, rods, cocci, or mixed organisms; secretion of mucus from the middle ear; or other otic conditions that might benefit from deep ear flushing.

Although alcohol components are included in many products as a disinfectant, isopropyl alcohol also helps with drying, reduces humidity, and helps prevent maceration. However, it is not a good agent for dissolving cerumen.[1]

CERUMINOLYTICS—DETERGENTS & SURFACTANTS

Cerumen is a natural, sticky moisture barrier that contains antimicrobial substances designed to protect the ear canal epithelium against damage from excessive humidity. Cerumen is formed from a mixture of epithelial cells and secretions from the apocrine and sebaceous glands.

Pathophysiology

Inflammatory skin diseases and contact allergens create inflammation in the ear canal. In response to hyperemia, the glands along the ear canal secrete excessive amounts of triglycerides and free fatty acids, which can act as substrate for infectious organisms.[2]

In addition, many conditions of the ear inhibit natural movement of surface keratinocytes toward the outside of the ear canal. This movement, called *epithelial migration*, is nature's way of moving material from the deep ear canal to the outside.

Areas of germinal epithelium, beginning at the eardrum and extending to the vertical ear canal, provide cells that migrate up the ear canal. When natural epithelial migration is inhibited, debris that accumulates along the ear canal needs to be removed.[3]

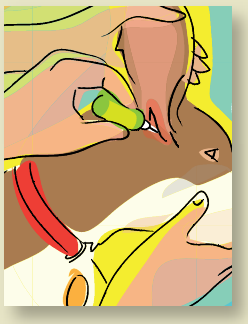
Debris Removal

Removing excessive debris within the ear canal is essential when treating the epithelial surface.

Surfactants, such as propylene glycol, lanolin, mineral oil, and even warm water, can act as a method of separating wax from the epithelial surface. Because wax floats in these solutions, it allows the wax to float out of the ear canal.

Detergent ear cleansers aid in emulsifying the waxes and oils that accumulate as excessive cerumen. Chemicals such as dioctyl sodium sulfosuccinate (DSS), squalene, chlorhexidine, and triclosan can emulsify oils, making them more water soluble and easier to remove from the ear canal.

- Detergents, such as DSS, should be restricted to in-hospital use as an initial ear cleanser because complete removal is difficult without use of copious



Ototoxicity

In many ear conditions, the integrity of the tympanic membrane cannot be determined without anesthesia and high magnification, such as with a video otoscope. The use of products that have the potential of causing damage in the deeper structures of the middle and inner ear, therefore, is an important consideration.

If the eardrum cannot be seen, then choose mild products with little potential for ototoxicity. Most reputable manufacturers include the statement ***Caution: Do not use this product if the eardrum is ruptured.*** When the product label contains any caution about use with eardrum ruptures, it has the potential to cause deafness and/or promote vestibular disease if the product gains access to the inner ear.

If the eardrum is perforated or ruptured, many products will cause excessive mucus production and inflammation when exposed to the mucous membrane lining the middle ear cavity.

warm water irrigation of the horizontal ear canal. In addition, DSS is potentially ototoxic if the tympanic membrane is ruptured.

- Chlorhexidine products have had some controversy surrounding their use, with 2% chlorhexidine-based ear cleansers contraindicated for use in ears and, therefore, withdrawn from the market.[4] Products with 2% chlorhexidine have a potentially profound ototoxic effect in both dogs and cats, resulting in necrosis and fibrosis of the hair cells of the cochlea and in the semicircular canals in the inner ear.[5]
- Although permanent deafness and/or vestibular signs have occurred in patients treated with products containing 2% chlorhexidine, recent studies[6] using 0.2% or less chlorhexidine ear products have failed to demonstrate any ototoxicity.

Assistance with Antimicrobial Therapy

Most otic drugs are not lipid soluble. Cerumen removal or dewaxing the ear canal before antimicrobial therapy allows topical medications to reach the infected, inflamed epithelial surface.

ACIDS

Acidic ear products contain organic acids alone or in combination with other substances to promote specific functions and decrease ear canal pH. For example, growth of *Malassezia* organisms can be inhibited by maintaining the ear's microenvironment at a pH of less than 5.5.[7]

Additional Functions

In addition to decreasing pH, some acids perform other vital functions:

- Salicylic acid helps dissolve dead skin cells and lactic acid and acts as a humectant to stimulate the growth of the basal epithelial layer.[8]
- Boric acid is known to have antifungal and desiccant properties.
- Acetic acid is a potent degreaser (**Figure 1**).
- Benzoic acid, citric acid, and malic acid are also ingredients found in ear cleansers.[7]

Acids are also recommended for use as disinfectants in the ear canal. Dilute acetic acid has been successfully used in treating yeast infections as well as ear infections caused by *Staphylococcus* and *Pseudomonas* species.[9]

Enhancing Antimicrobial Effect

The use of topical otic antibiotics immediately following an acidic ear treatment usually is not advised. Waiting 4 to 6 hours after an acidic ear cleanser treatment before administering antibiotic ear drops may help the antibiotic have a more potent effect.[10]

The use of otic antifungals in an acidic medium actually enhances the antifungal effect. For topical ketoconazole, decreased pH enhances binding to the corneocytes, resulting in more prolonged antifungal activity.[11]

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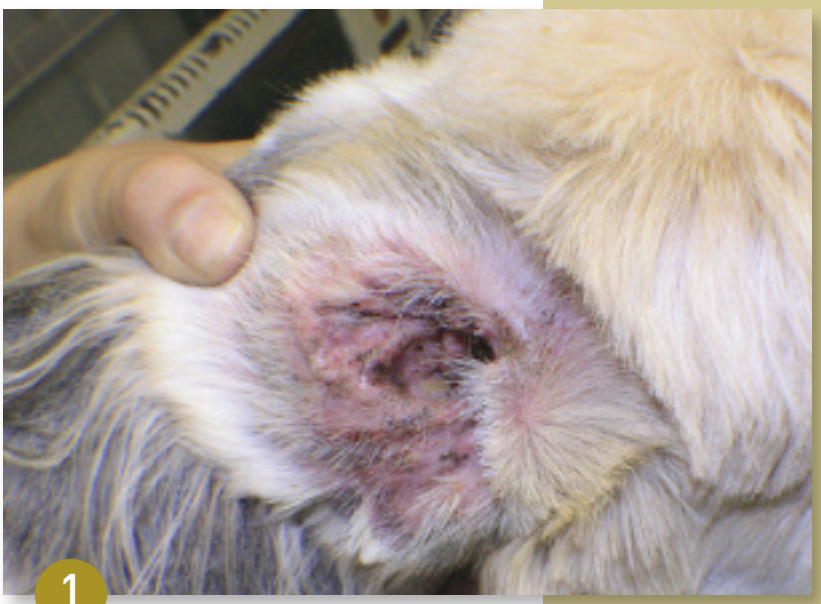

1

This dog has bilateral otitis with erythema and pruritus of both concave pinnae. Cytology revealed 4+ yeasts in both ears. An acetic acid–boric acid flush twice daily is beneficial in removing wax and reducing pruritus and erythema. Acidic ear flushes also help inhibit yeast reproduction.

FIND MORE...

See **Flushing the External Ear Canal** on page 87 for step-by-step instructions on cleaning the canine ear.

DSS = dioctyl sodium sulfosuccinate

ALKALIZERS

Alkaline ear products have been shown to enhance the antimicrobial effect of many aminoglycoside and fluoroquinolone antibiotics (**Figure 2**).[8,12]

2

This dog's ear is producing copious liquid exudate consistent with a gram-negative bacterial infection. Twice-daily ear canal flushing with a tris-EDTA product with or without chlorhexidine (for gram-positive organisms) is beneficial in improving the effect of topical antibiotic therapy.

Functions of Tris-EDTA

As a specific alkalizer, tris-EDTA (trisamino-methamine–ethyl-enediaminetetra acetic acid) is a common ear product for treatment of gram-negative otic infections:

- Tris-EDTA has been shown to chelate the calcium and magnesium ions that make the cell membrane hard to penetrate. Tris-EDTA dismantles the cell membrane of gram-negative bacteria that makes it more porous, thereby allowing a higher concentration of antibiotic to enter the cell and kill it.
- When EDTA is maintained at a pH of 8 in the ear canal with tris buffer, topical antibiotic treatment of gram-negative infections is considerably more effective.[13]
- Tris-EDTA also helps inactivate the efflux pumps that are genetically programmed into antibiotic-resistant gram-negative bacteria.[14] Efflux pumps use an active transport mechanism within the cell membrane to extrude foreign compounds from the cytoplasm of the bacteria.
- Tris-EDTA has demonstrated powerful binding properties to elastase, an enzyme that is part of the collagenases elucidated by gram-negative bacteria, especially *Pseudomonas* species. Binding elastase in the ear canal helps reduce the cytopathic effect of the collagenases on the epidermis that results in ulceration and deep tissue invasion.[15]

Tris-EDTA Combinations

Many tris-EDTA products are being formulated with other ingredients (eg, 0.15% chlorhexidine) that can help treat gram-positive infections in a mixed bacterial ear infection. Ketoconazole has been added to some tris-EDTA products to help prevent yeast overgrowth, which results from maintaining a very alkaline ear canal during treatment of gram-negative organisms.[16]

TAKE-HOME POINTS

- Cerumen, a natural, sticky moisture barrier, contains antimicrobial substances designed to protect the ear canal epithelium against damage from excessive humidity.
- Cerumen removal before antimicrobial therapy allows topical medications to reach the infected, inflamed epithelial surface.
- Detergent ear cleansers aid in emulsifying waxes and oils that accumulate as excessive cerumen.
- DSS and similar detergents should not be used by owners for at-home ear cleansing but instead should be restricted to in-hospital use.
- Salicylic acid helps dissolve dead skin cells, while lactic acid acts as a humectant to stimulate the growth of the basal epithelial layer.
- Tris-EDTA is a common ear product for the treatment of gram-negative otic infections. For mixed-bacterial infections, tris-EDTA products are being formulated with other ingredients that treat gram-positive infections.

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

DSS = dioctyl sodium sulfosuccinate; tris-EDTA = trisaminomethamine-ethylenediaminetetra acetic acid