Proceeding of the NAVC
North American Veterinary Conference
Jan. 8-12, 2005, Orlando, Florida

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OTITIS
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Otitis is a common clinical complaint. It can simply be defined as acute or chronic inflammation of the epithelium of the ear. When otitis externa is acute or chronic, inflammation of the external canal from the tympanum to the pinna and otitis media is inflammation of the tympanic bulla. Common conditions are easily identified and treated, but can also lead to chronic disease if not managed well. An aggressive and logical approach to managing the “common” otic condition is the best prevention. There are six major points to consider when treating otitis:

1. Identify and manage the primary cause
2. Correct predisposing conditions if possible
3. Do a complete dermatologic examination in every case
4. Identify and manage middle ear disease
5. Thoughtfully select medications based on all of these factors plus cytologic evaluation of otic material
6. Treat with the correct dose for an appropriate course

NORMAL ANATOMY OF THE EAR CANAL
Understanding the normal anatomy and physiology of the ear and recognizing abnormal conditions will provide the basis for developing an appropriate treatment plan. The ear canal is a cartilaginous structure lined with skin. Hair follicles, sebaceous and apocrine glands line the ear canal to the level of the tympanic membrane. The tympanic membrane is modified epithelium and separates the external canal from the middle ear. Glandular secretions and desquamated epithelial cells work together to trap debris. Cerumen and epithelial cell migration move debris away from the tympanic membrane and out of the canal. In a normal ear you should see a smooth skin surface with occasional hair and an intact, translucent tympanic membrane. The normal or healthy external ear canal of most dogs and cats harbor small numbers of commensal gram positive cocci and Malassezia sp. These organisms are potentially pathogenic if the microenvironment is changed to encourage overgrowth. A stained smear can quickly determine if microbial overgrowth is present.

PATHOGENESIS OF OTITIS
Factors resulting in otitis have been divided into 3 areas; predisposing factors, primary factors, and perpetuating factors. The pet’s history and your examination should be thorough and aggressive early in the disease to sharpen the lines among the groups.

Predisposing factors are risk factors that rarely cause otic disease by themselves but can change the microenvironment to favor the development of otitis. Environmental conditions (moisture, heat, topical medications), anatomical variations (stenotic canals, pendulous ears, genetic increases in relative numbers of glands or follicles), or systemic or immunosuppressive disease are considered predisposing factors. Primary factors will cause otitis without predisposing or perpetuating factors. Primary factors include tumors, foreign bodies, parasites, hypersensitivities (atopy, food allergy, contact allergy), or keratinization disorders (endocrinopathy, idiopathic seborrhea, autoimmune disease, nutritional disorders). Perpetuating factors include bacteria, yeast, progressive pathologic changes, inappropriate therapy and otitis media. These factors cause therapeutic failure most often but are often the easiest to identify.

PATHOPHYSIOLOGY OF OTITIS EXTERNA
Erythema and edema are the earliest signs of otitis and reflect acute inflammation. Inflammation causes changes in the microenvironment (increased heat, moisture) of the ear and encourages the establishment of infection. With time, epidermal and glandular hyperplasia with increased glandular secretions develop, epidermal cell migration is impeded and cerumen accumulates in the ear. Chronic disease leads to ossification of the cartilage and pain.

The tympanic membrane can get damaged with otitis externa. The tympanum is considered abnormal when it is thickened, loses its transparency, or is discolored. It can become dilated and invaginate into the middle ear forming a false pocket, or it can rupture and re-epithelialize. Any change in the integrity of the tympanum should prompt assessment for otitis media.

PATHOPHYSIOLOGY OF OTITIS MEDIA
Otitis media implies that the eardrum is ruptured or has been ruptured in the past. Although rare, it can also occur from ascending nasal or respiratory infections via the auditory tube or from hematogenous spread. A rupture in the tympanic membrane may occur at any point in the course of otitis, from acute to chronic. The tympanic membrane is capable of re-epithelializing once ruptured, so otitis media can be present with an intact tympanum. Otitis media should be suspected any time the tympanic membrane is ruptured or absent, appears discolored or opaque, or when it bulges outward with fluid behind it. Otitis media is also suspected with chronic or recurrent conditions, if there is a proliferative otitis, or if there are signs of facial or sympathetic nerve damage.

DIAGNOSTIC EVALUATION
Erythema, swelling, malodor, otic discharge, pruritus, pyotraumatic dermatitis, head shyness and pain are common presenting complaints. A complete history, with details on onset, duration, and progression of the condition, a list or summary of medications used, and response to therapy is the first step. A complete dermatologic examination should precede the otic exam and will provide basic clues to develop a logical short differential diagnosis list.

A complete otic examination includes both physical and cytological evaluations. Palpate the canal and assess degree of fibrosis or calcification of the cartilage. This judgment will determine the prognosis and potential course of therapy.

Cytologic evaluation of any otic material present is mandatory for selecting therapy. Remove a small amount of exudate, roll it on a glass slide, heat fix it, and stain with a three step stain such as Dif Quik. If cocci or budding yeast are present without evidence of PMNs, then topical therapy will suffice. Neutrophils, toxic neutrophils and phagocytized bacteria all indicate a systemic response to the infection and demands the use of systemic antibiotics. If rod type bacteria are seen, a culture is taken to identify the organism. A cytology should be done at each subsequent visit in order to track response to therapy and determine when the infection is finally resolved. If there is no evidence of infection or inflammation but the ear is red and pruritic, you are
witnessing a classic hypersensitivity reaction and the otitis should be treated as such.

An otoscopic exam of both ears is mandatory. If unilateral otitis exists, the “normal” ear should be evaluated first. A hand held otoscope and otoscopic cone are the basic tools needed to examine the ear canal, and visualization of the canal and tympanic membrane is enhanced with the use of an endoscopic otoscope. The lining of the canal should be visually evaluated for severity of erythema, edema, proliferation, and diameter. The epithelium should be evaluated for the presence of ulcers, growths, or foreign bodies. Determine if the tympanic membrane is present and healthy. A thorough examination may not be possible if the canals are edematous, stenosed or painful so a course of topical and systemic glucocorticoids may be required to open the canal prior to the exam. Sedation or anesthesia is often required during the exam. Record findings in the patient’s medical record.

Bacterial culture with antibiotic sensitivity testing should be performed on chronic infections that have failed to respond to appropriate therapy, when rod bacteria are present on cytology, and when otitis media is suspected or identified. Samples for culture should be taken from both the external canal and middle ear if the eardrum is ruptured.

MEDICAL MANAGEMENT
Medical management of otitis externa should be aggressive, specific for this patient, and thorough in order to avoid the development of chronic changes and resistant infections. The focus for treating any otic condition is to identify the primary cause and manage or eliminate it. Perpetuating conditions should be treated aggressively and predisposing causes addressed and managed early in the course. Treat acute otitis externa based on the cytologic and otoscopic exam with a two-weeks course of a q12-24h topical broad spectrum product. Systemic glucocorticoids may be needed to reduce swelling and pain. A pivotal part of your success or failure in managing a chronic ear condition is how well you explain the current state, the treatment options, the projected outcome of each option, and your expectations in each unique case. An informed client is a compliant client. Most importantly, you must start with a clean ear.

EAR CLEANING AND FLUSHING
An ear must be clean before it is medicated. Large amounts of debris may be packed deep in the canal and must be removed. Debris can exacerbate inflammation, impede visualization of the tympanum, and inactivate topical medications. General anesthesia is required for a thorough cleaning to occur. Some dogs are quite painful and the canals occluded because of swelling and debris. A 3-14 day course of prednisone (0.5 mg/kg/day to QOD) prior to the sedative procedure is often needed to open the canal and reduce pain.

Preparation involves assembling all supplies needed for the flush, anesthetizing your patient and placing an endotracheal tube, and obtaining samples for cytology and culture before putting anything in the ear. If the exudate is suppurative, then a gentle flush with warmed saline may be adequate to remove the debris. A ceruminolytic agent can be used to loosen more tenacious material.

Epi-Otic and Cerulytic (Virbac), Adams Pan-Otic (Pfizer), or Cerumene (Vetquino) are relatively gentle cerulytic products that help soften the debris before the flush. For exceptionally tenacious or impacted material a product containing carbamide peroxide and DSS (Clear X - DVM Pharmaceuticals) is especially useful. Any one of these products should be allowed to stay in contact with the exudates for at least 10 minutes before flushing, then copious amounts of warmed water or saline is used to remove the solution and debris. If the ceruminolytic gets into the middle ear, all of it must be flushed out.

Use a soft pediatric rubber bulb syringe to remove the bulk of the material, but do not use too much force or pressure. A gentle back flow of solution indicates that the right amount of pressure is being used. Check your success visually with an otoscope, then follow with a directed flush using a feline urinary catheter or a 12 French red rubber catheter attached to a 12 cc syringe filled with saline visually guided with a hand held otoscope or video otoscope. The same syringe and catheter is used to remove excess water and debris. Occasionally large pieces of debris accumulate at the level of the tympanum. An ear curette or loop or a grasping endoscopic forcep can help remove these large pieces of debris.

Remember that these are chronically damaged ear canals. Underneath the debris the epithelium is quite fragile and will ulcerate and bleed very easily. Use cotton tipped applicators sparingly as these can often push debris further into the canal and cause a fragile epithelium to bleed. After the debris is removed, check the integrity of the tympanum. If it looks normal and the canal is clean, instill an appropriate antimicrobial (based on cytology), give 0.5 mg/kg of prednisone to limit post-procedural swelling, and dispense an oral antibiotic pending the culture results. All medications can be adjusted once the culture results are evaluated but a 4 week course of antibiotic is standard. A 7-10 day post-procedural evaluation is required to make sure a satisfactory response is achieved.

If you discover that the eardrum is discolored, opaque, or bulging toward you, a myringotomy may be needed. These should not be pursued lightly. Certainly complications are possible with this procedure (Horner’s, facial nerve paralysis, deafness and vestibular problems) and an owner should be carefully counseled on this possibility before the procedure is done.

The rupture can be made with a sterile 20g spinal needle, a sterile 20 g polypropylene intravenous catheter, a 3.5 French urinary catheter, or a sterile Calgiswab (Hardwood Products) through a sterile otoscopic cone using an otoscope. The opening is only safely made in the ventral most portion of the tympanum. Force a hole in to the tympanum on the ventral portion (between 5-7 o’clock) of the pars tensa. The same calgi swab used to create the rupture can also be used to sample the material in the middle ear. If a catheter is used, a sample is aspirated and a portion submitted for culture and a portion placed on a slide for cytology. The middle ear is then very gently flushed through the catheter with warmed saline or Tris EDTA solution until the flush runs clear. The excess saline is aspirated, then Tris EDTA plus an antibiotic is instilled in the middle ear. After care is similar to that described in the previous section and includes a 4-8 week course of topical and systemic antibiotics and a tapering dose of glucocorticoids.

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SELECTION OF APPROPRIATE DRUGS

The most frequently isolated pathogens from chronic external and middle ear infections include *Staphylococcus intermedius*, *Malassezia pachydermatis*, *Pseudomonas sp*, *Proteus sp*, *E. coli*, and *Enterococcus*. Selection of both systemic and topical antimicrobial medication is based on clinical assessment and cytologic findings. Most otic preparations are combination drugs (glucocorticoids plus antibiotic plus or minus an antifungal) in an oil or ointment base. Oils or ointments are less desirable than solutions or suspensions when moist exudate is present. If the canal is stenotic, or where the eardrum may be ruptured. Solutions and suspensions are primarily water, may contain an astringent, and may evaporate over time thus helping to dry the ear. If there is a mixture of cocci and *Malassezia* with inflammation clinically, then one of the several combination products containing an antibiotic, steroid and antifungal is appropriate. There are so very many products on the market that it is impossible to list all of them here so it is imperative that you know the active ingredients in the products you use. The reference by Morris provides a good review of the contents of many commercial products.

When inflammation is a perpetuating condition, managing this specifically with the use of steroids will impede the development of chronic changes. Corticosteroids reduce exudation, pain, pruritus, swelling, decrease glandular secretions, and can reduce proliferative changes. Topical glucocorticoids are absorbed systemically so the least potent corticosteroid that will reduce the inflammation should be used. If the ear is red and swollen, but only squamous epithelial cells are seen on cytology, then a 1% hydrocortisone product such as BurOtic HC (DVM Pharmaceuticals) or 1% Hydrocortisone (Vet Solutions) is appropriate. Many combination products contain dexamethasone, triamcinolone, or betamethasone. Synotic (Fort Dodge) contains 0.01% Fluocinolone acetonide and 60% DMSO and is the most potent topical otic steroid in the veterinary market. It is useful in both acute and chronically inflamed ears but you must keep in mind it's potential for systemic absorption.

If rods are seen on cytology, if the otitis has failed to respond to appropriate therapy, or it is chronic (≥ 6 weeks) a culture should be taken. Empirical use of an aminoglycoside or a fluoroquinolone is appropriate pending culture results. Be sure to adjust medication based on these results and extend treatment until clinical resolution. Remember that resistance to a particular antibiotic in vitro may not correlate with clinical response. Direct application of medication to the ear canal will result in a higher antibiotic concentration than with systemic medication. On the other hand, an oral dose that is higher than that recommended by the manufacturer may be required to reach therapeutic levels in ear tissue and successfully treat a resistant *Pseudomonas* infection in the middle ear. Measurement of antibiotic mean inhibitory concentrations (MIC) will allow judicious selection of an antibiotic in these difficult cases.

A relatively new product described as being an otic enzymatic solution can be used to treat acute and chronic bacterial and yeast infections without antibiotics. It uses a "unique three point milk derived enzyme system that is antimicrobial in its effect." The product, Zymox (Pet King Industries, Inc), contains lactoperoxidase which inhibits various bacterial metabolic enzymes, lysozyme that inhibits cell wall constituents and lactoferrin an iron binding protein. These enzymes reportedly interfere with normal bacterial or yeast metabolism resulting in death.

Systemic antibiotics are indicated when topical medications have been ineffective, in chronic cases of otitis externa, where phagocytized bacteria is seen on cytology, and in any case of otitis media or proliferative otitis. The bulla is highly vascular so systemic antibiotics are likely to concentrate in an inflamed middle ear. Potentiated sulfonamides (SMZ-TMP 22mg/kg q12h; ormetoprim sulfadimethoxine 27mg/kg first day then 13mg/kg/24h), cephalosporins (cephalexin 22 –33 mg/kg q12h; cefpodoxime proxetil, 5-10 mg/kg/day), chloramphenicol, (50 mg/kg q8h), fluoroquinolones (marbofloxacin 0.75- 5.5 mg/kg/q24h; enrofloxacin 5-20 mg q24h, orbafloxin 5-10 mg/kg/q24h, difloxacin 5-10mg/kg/day), and amoxicillin clavulanate (22 mg/kg q12h) are all good choices. I attempt to use the same class of antibiotic topically and systemically to maximize its concentration at the point of desired effect. Treatment should be selected based on culture/sensitivity results and continued for at least 4 weeks or until the infection is resolved. Resolution is assessed as absence of pain or pruritus, no erythema or edema, and the absence of organisms or inflammatory cells on cytology.

Antifungal agents (thiabendazole, clotrimazole, miconazole) are used with *Malassezia* or Candida infections and are available in a variety of topical medications. Ketoconazole (5-10 mg/kg/day), itraconazole (5 mg/kg/day) or fluconazole (5 mg/kg/day) may be used systemically for the treatment of yeast otitis. These antifungal medications achieve sustained levels in sebaceous glands, hair follicles, stratum corneum and nails. Itraconazole in particular has been demonstrated to be effective against *Malassezia* dermatitis when given on a pulse dose schedule (two days each week) thus lowering the cost and the potential for side effects. The pulse dose may not be as effective for *Malassezia* otitis.

CLIENT EDUCATION

Maintenance ear care prevents reoccurrence of acute infections, insures success in treating chronic ear disease and decreases inflammation, insuring that the canals stay patent. Many owners do not know how to properly clean an ear, often over do it and can actually make a bad situation worse. It is important to teach your staff how to teach owners how to clean their pet’s ears. It is rarely necessary to clean the ear more often than every other day because frequent cleaning tends to keep the ear canal wet. Owners must be advised to treat ears gently because the epithelium is often quite fragile; rough handling results in erosions and ulcerations, which slow the healing process. Owners should also be advised that cleaning more often is not necessarily better for these reasons and that overuse of cleaning agents can cause irritation. If the ear becomes more inflamed or the ear is more painful after use of a product, stop using it. Provide a handout that explains the cleaning technique, and that can be filled out at the time of discharge with the specific medications being dispensed.
SUMMARY

Understanding the normal anatomy and physiology of the ear and recognizing abnormal conditions will provide the basis for developing an appropriate treatment plan for the simplest otitis. A working knowledge of both normal and abnormal anatomy, pathogenesis of the diseased state, and knowledge of the individual ingredients in the product we choose to use is required. Early intervention with aggressive, systematic medical treatment is needed to terminate the relapsing cycle of chronic otitis.

A chronic or re-occurring condition requires exploration and identification of a primary cause as well as a thorough dermatologic and otic exam. Select medications based on your findings and use glucocorticoids to reduce inflammation and discomfort. Finally, a significant part of your success or failure in managing otitis is how well you explain the current state, the treatment options, the projected outcome of each options, and your expectations in this unique case. Client education is fundamental because an informed client is a compliant client.